SIXTY-SEVENTH YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

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THE AIRSHIP "SUCHARD" OF THE BRUCKER TRANSATLANTIC EXPEDITION

To counteract the sudden increase in buoyancy produced when the rays of the rising sun in the tropics strike the balloon, water ballast is taken in by scoops on the end of drag line and a spray of cooling water is spurted over the envelope.—[See page 62.]

SCIENTIFIC AMERICAN

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record, accurately and in simple terms, the world's progress in scientific knowledge and industrial achievement. It seeks to present this information in a form so readable and readily understood, as to set forth and emphasize the inherent charm and fascination of science.

Sex and Scientific Recognition

HAD the incident occurred a quarter of a century ago we could have understood better the discussion which has been provoked in that august body, the Academy of Sciences, Paris, by the candidature of Madame Curie for membership. Respect for custom and tradition is an admirable attitude if it be judiciously tempered by due considerations of time, place and personality; but we cannot help feeling that in this advanced age, in such a center of enlightenment as Paris, and where a scientist of such brilliant performance as Madame Curie is concerned, this discussion as to whether she is eligible for admission to the Academy of Sciences, is altogether deplorable. When science comes to the matter of bestowing its rewards it should be blind to the mere accident of sex; and one does not have to be an enthusiast on the subject of the extension of the rights and privileges of her sex, to feel that here is a woman who, by her brilliant achievement, has won the right to take her place with her compeers in the Academy, or any similar institution devoted to the furthering of science. The scientific world will undoubtedly agree with Gaston Darboux, Secretary of the Academy of Sciences, in urging the right of Madame Curie to succeed to the position of which her late husband was next to the last occupant.

As far as the learned societies of other countries are concerned, the election of a woman to the Academy would certainly not be without precedent. Several foreign bodies, indeed, including the Philosophic Society of Philadelphia, have already welcomed her into their membership. Darboux instances the case of the Countess Ersilia Lovatelli, who, as dean of the Archæological section of the Royal Academy of Italy, took a prominent part at a recent meeting of the Academy of Rome, and also that of Elise Wendel, who was a prominent figure at Berlin in 1900 during the centennial celebration of the German Academy of Sciences. To these cases we might add those of Hertha Ayrton, the only woman member of the Institution of Electrical Engineers of Great Britain, who was considered eligible for election to that distinguished body, because of her discovery of the laws governing certain phenomena of the electric arc, and that of Lady Margaret Lindsay Huggins, who, because of her valuable work in astronomy and her contributions to the journals devoted to that branch of science, was elected an honorary member of the Royal Astronomical Society.

Elsewhere in this issue reference is made to the fact that a statistical study of American men of science has led Prof. Cattell to draw attention to the fact that women are contributing but a very small share to productive scientific work. If this be so, it is obvious that to contest the right to recognition of such women is further to discourage the entrance of women into a sphere of work in which their patience, intelligence, and strong intuitive perception render them peculiarly well fitted to labor.

Indorsement of the Reclamation Service

IT is seldom that a report on an important public work has afforded us greater satisfaction than that recently made by the army engineers who were appointed to investigate the work so far done by the United States Reclamation Service. We were particularly anxious that the report should be favorable, and this for the reason that the engineers in charge of this great project have been permitted to carry it on without that political interference which in the past has been so often disastrous to work of this character. The organization of the engineering staff of the Reclamation Service is excellent; the men have been carefully selected; and they have done their work with an *esprit de corps* and zeal which have won for this project the unqualified commendation of the technical press. The army engineers are noted for the strict impartiality with which they investigate public work on which they are called to report, and such criticisms as they have made on the work of the Reclamation Service show that in this particular they have spoken without fear or favor.

For these reasons, the nation is to be congratulated on the fact that the board considers the engineering structures of the various projects to be on the whole well designed and well built. "Some of them, as the Pathfinder Dam, the Shoshone Dam, the Roosevelt Dam, and the Gunnison Tunnel, are monuments reflecting great credit on both designer and builder." Regarding the cost of the works, the Board states that it has almost invariably exceeded the original estimate, and that this increase in cost has naturally caused great discontent among the settlers. It was due partly to a general increase in the cost of labor and material; partly to underestimates and an insufficient allowance for contingencies; and partly to the necessity for doing more work than was originally contemplated. In justice to the engineers, it should be pointed out that at the time the works were started, the question of low cost was not made paramount, the Executive, indeed, having made it understood that every possible means was to be used to hurry forward the various undertakings. The experience gained in these earlier works, however, has made it possible to estimate very closely the cost of the later projects. In any case, it is a fact that although many of the works cost much more than was estimated, they have been built at a lower cost than works of the same character that were constructed at the same time in the eastern States.

The Selden Patent

THE recent decision of the United States Circuit Court of Appeals, reversing the decree of the lower tribunal, which upheld the famous Selden patent, marks the latest phase of this extensive and complicated series of law suits. The case is one of note mainly because of the vast commercial interests involved, and not by reason of any new legal or technical principles determined thereby. The patent law and the decisions upon which the complainants and the defendants sought to support their respective contentions are, in the main, fundamental and long established, and the issue became practically one of fact. In view of this consideration, the present decision probably constitutes the final chapter of the litigation, for should the complainants apply for a writ of certiorari, in order to take the case to a Supreme Court, it is doubtful if the latter will consider the case, as no question of law requires its determination. The parties to the suits embrace almost the entire gasoline automobile industry of this country, divided into two groups, in one of which are included the licensed dealers, banded into an organization conceding the validity and the broad scope of the Selden patent and paying tribute to the owners thereof, in the form of royalty, in the other of which are found the independent dealers, who refuse to acknowledge the contentions of the owners of the patent, and thus became the defendants in the suits brought for the alleged infringement.

Regardless of any technical questions of validity and of scope, the Selden patent is an interesting one in that the application for it was filed sixteen years before the patent was granted. The inventor, George B. Selden, himself a patent attorney, filed his application in 1879, and during its skillful prosecution took full advantage of the periods of inactivity permitted by Patent Office practice, delaying its grant so long that the issue of the patent did not take place until 1895. When the application was filed, the automobile industry had barely received its inception, but in the period during which the application lay dormant, developed to such an extent that at its issue the patent disclosed nothing to the public which it did not then already know, and upon which, in fact, it had not already improved. In this way came about the anomalous situation that a pioneer patent appeared before the world, which purported to be a monopoly of an industry already well developed by others working independently of the patentee. However, as the inventor followed strictly the statutes and rules of procedure, the courts cannot exact of him a greater measure of diligence than he exercised. In his able and scholarly decision, Judge Hough of the Circuit Court says: "No litigation closely resembling these cases has been shown to the Court, and no instance is known to me of an idea being buried in the Patent Office, while the world caught up to and passed it, and then embodied in a patent only useful for tribute."

The Selden patent purports to be for a "road-locomotive," and the essence of the invention therein is set forth in the first claim, which alone need be considered for the purpose of the present discussion. The inventor identifies the object of the invention as the "production of a safe, simple, and cheap road locomotive, light in weight, easy to control, and possessed of sufficient power to overcome any ordinary inclination." The first claim comprises, in combination, six elements, all of which were old generically, in the prior art, at the time of the filing of the Selden application. This is admittedly the case. The question of aggregation was raised by the defense, but both the lower and the appellate tribunals are agreed in holding that the claim is a proper combination. The combined elements in the claim may be arranged in three groups. First, the *carriage*, including the running gear, the body, the propelling wheel, and the steering mechanism. Secondly, the *drive*, including the power shaft and connections, and the intermediate clutch or disconnecting device, and thirdly, the *engine*, including the liquid fluid receptacle. When it is conceded that all the elements of the claim are old in the prior art, the question at once becomes a simple one of fact: Did it require the exercise of the inventive faculty to produce this combination, or if the combination itself was already indicated in the prior art, was any one of its elements so altered or adapted by the inventor that the combination thereby became patentable? In the claim, the engine element is the one which required the most extended consideration. In fact, it is the essential feature of the patent. The prior art showed the elements *per se* of the claim to be old. It also showed a combination of elements similar to that of the claim, with the exception of the specific engine. But the prior art also showed a combination including a gas engine. Selden, in the claim, sets forth that the engine of the combination must be "a liquid hydrocarbon gas engine of the compression type." No such engine, in a similar combination, was shown by the prior art. Judge Hough of the Circuit Court held that this constituted invention. The Circuit Court of Appeals, Judge Noyes rendering the opinion, held in effect, that while there might be invention in the combination, the gasoline automobile of to-day does not use an engine the equivalent of that employed by Selden, and that therefore, there is no infringement.

At the time that Selden made his invention, the gas engine was already well known, two leading types being the Brayton and the Otto. These two engines, while both might be classified as "liquid hydrocarbon gas engines of the compression type," are, it is held by the Appellate Court, not equivalent, and can be clearly differentiated. Without going further into the technical question of this difference, it may be stated briefly that the Brayton engine is practically non-existent at present, and that the Otto engine of Selden's day is the prototype of the internal combustion engine now in general use. The Brayton engine is of the so-called slow combustion constant pressure type; the Otto of the constant volume, or explosive type. Judge Hough of the Circuit Court held that the state of the art clearly permitted the Selden patent to be regarded as a pioneer one, and that correspondingly, it is entitled to a broad range of equivalents in its interpretation. For this reason, he regarded the Otto type of engine used in the gasoline automobile of to-day, as the equivalent of the Brayton type of motor employed in the combination by Selden. The Circuit Court of Appeals herein differs from the decision of the lower court, and while admitting that the Selden patent is valid, and that it is to a certain extent of pioneer character, decides that the state of the prior art was such that the patent is entitled to a fair and reasonable, but not broad range of equivalents, and that this range is not of such scope as to permit the substitution of the Otto type of motor for the Brayton engine specifically employed by Selden. On this ground the Circuit Court decision was reversed.

A System of Multiplex Telephony and Telegraphy

Major George Owen Squier's Gift to the Public

AN entirely new field in telephony and telegraphy has been opened by the patents just granted to Major George Owen Squier, of the United States Signal Corps, who, with remarkable generosity, has made his invention a gift to the public. It is difficult to classify this new system of communication. It is not exactly wire telephony, nor is it wireless telephony or telegraphy, but it occupies a position midway between, combining many of the advantages and eliminating many of the disadvantages of each.

In wire telephony we have one of the most delicate and economical uses of commercial electricity, the amount of current employed being astonishingly small, but the very delicacy of the system makes it impossible to transmit a message to any considerable distance without loading the line with Pupin coils. Wireless telegraphy, on the other hand, is absurdly wasteful of electrical energy. It is like using a blunderbuss to kill a gnat. In order to send a message across the Atlantic, we must create a tremendous disturbance in the ether on our side of the water, using many horse-power in electrical energy to start a set of waves that spread out with equal intensity in all directions, to the north, to the west, and the south, as well as eastward across the water, and by the time they do reach the other side, it requires the most delicate of instruments to detect them and transform them into sound waves barely within the limits of audibility. Of course, this defect of wireless telegraphy was recognized long ago, and attempts to direct the course of the waves only toward the receiving station for which they were intended have been made, but with comparatively little success.

In his study of this subject, in connection with the work of the United States Signal Corps, Major Squier has discovered that by reducing the frequency of the oscillations to a lower number than heretofore used in wireless telegraphy, it is possible to direct the energy along a wire. At first thought, one would be inclined to question the advantage of such a system over ordinary wire telephony and telegraphy, but Major Squier has found that by means of proper attunement, such as is employed in wireless systems, a large number of conversations may be carried on over a single wire at the same time, or, if desired, Morse telegraph signals may be used instead, without in the least interfering with the ordinary battery telephonic message. Furthermore, as the electro-magnetic waves are not conducted through the wire, but are merely directed by it, they are not subject to ohmic resistance, as are ordinary telephonic currents, so that they provide a means of communicating over much greater distances than have heretofore been possible.

The oscillations in an ordinary telephone circuit are limited by the inertia of the diaphragms in the receiver and the transmitter. In addition to this, there is a limit imposed by the ear, which is unable to detect vibrations of less than 16 per second and of more than 15,000 to 20,000 per second. It is well known that in ordinary line telephony the current is distributed quite uniformly throughout the cross section of the conductor, but that as the frequency increases, we have what is commonly known as "skin effect," this being a tendency for the current to leave the heart of the conductor and seek the surface, and eventually with further increase of the frequency, to leave the conductor entirely and be stored in the ether surrounding it. A still further increase of frequency results in radiation of the energy from the conductor, as in wireless telegraphy. Major Squier has found by experiment that frequencies up to 100,000 cycles per second are so bound to the conductor that there is very little radiation. The frequencies used in wireless telegraphy range from this point up to several million per second. Major Squier's system, then, embraces the range between 20,000 and 100,000 cycles, with which, on one hand, there is no danger of affecting the battery instruments, owing to their comparative sluggishness, while on the other hand, there is no fear of loss by radiation. This range is so great that by using methods of attunement, it is possible to send a series of wave trains along the wire, which are quite distinct from each other, and which may be selectively separated by receiving instruments that are respectively synchronized with the transmitting instruments. Using these wave trains as vehicles of communication, it is a simple matter to impress upon them variations and modifications corresponding to the human voice by means of microphone transmitters, as in wireless telephony. The receiving instrument will then pick up the particular wave train to which it is attuned, and, by means of detectors and receivers, such as are commonly used in wireless telephony, will reproduce the human voice. Apparently the vexing problem of multiplex telephony has been completely solved. Major Squier's invention is capable of a large number of different applications and modifications, all of which have been carefully covered in four patents. We have selected two drawings from these patents, one of which represents the high-frequency system bridged across the wires of a common telephone circuit, while the other shows a high-frequency system introduced directly into one of the wires of a battery telephone line, while the earth is used as a return.

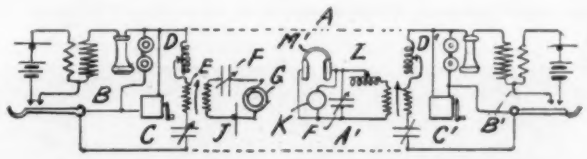


Fig. 1.—New system bridged across a telephone line.

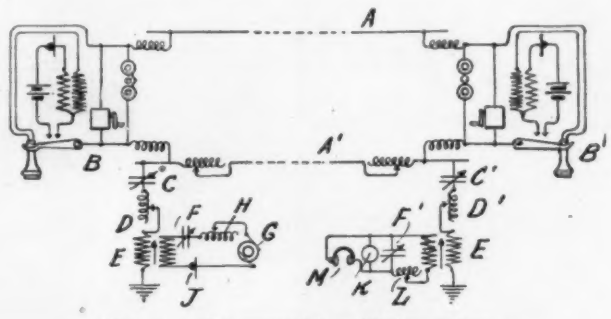


Fig. 2. —The grounded multiplex system.

Major George Owen Squier of the United States Signal Corps.

A SYSTEM OF MULTIPLEX TELEPHONY AND TELEGRAPHY

Photographed by Harris & Ewing.

In Fig. 1 we have a telephone line indicated at AA'. Any ordinary telephonic circuit may be used. Major Squier in his experiments employed the regular twisted pair of paper-insulated, lead-covered cable. The ordinary receiving and transmitting telephone sets are shown at BB', bridged across the line. A high-frequency circuit is also bridged across the line, consisting of a condenser C, variable inductance D, and the primary of a transformer E. The secondary of this transformer forms part of the generator circuit, consisting of a condenser F, high-frequency generator G, and microphone transmitter J. The receiving set of the high-frequency system is indicated at the other end of the line, consisting of condenser C', variable inductance D', transformer E, the secondary of which forms part of the oscillatory circuit, consisting of the variable inductance L, detector K, condenser F, and receiver M'. The variable inductance L' permits of tuning the oscillatory circuit to the frequency of the generator circuit. The detector K is of the type commonly employed in wireless telegraphy. While these systems are bridged across the line, they do not interfere with the battery circuit, owing to the condensers C and C', which are of very small capacity, being measured in thousandths of a microfarad. These condensers also prevent currents of ordinary telephonic frequency from affecting the high-frequency receiving sets. In order to adapt this system for a large number of high frequency sets operating at the same time, the primary of the transformer E may be made variable, or other means may be adopted to provide for selected tuning. Instead of bridging the lines of the telephone circuit, it is possible to superpose the high-frequency waves upon them inductively by placing the secondary of the transmitting station and the primary of the receiving station in series with the line.

In Fig. 2, which shows the grounded system, the parts corresponding to those shown in Fig. 1 are similarly lettered. The inductance coil H provides for the necessary attunement of the generating circuit, and the variable inductance L for that of the oscillatory receiving circuit. In addition to this, tuning coils are inserted in the line to assist in careful attunement. By using the earth as a return, it is possible to employ the two wires A and A' as separate circuits, thus further increasing the number of communications possible over a single commercial telephone circuit. Major Squier's fourth patent also covers a grounded system, in which a number of high-frequency circuits are connected in series relation.

It is difficult to foretell just what Major Squier's inventions may lead up to. The fact that they do not require any special apparatus that has not already been tried out either in wire telephony and telegraphy, or in wireless systems, makes them doubly valuable. It seems remarkable that electro-magnetic waves may be employed within the cables of a telephone system, but Major Squier has found that the oscillations appear to be confined in the infinitesimal layer of ether separating the wires of a twisted paper-insulated pair of telephone conductors. The commercial possibilities of this high-frequency line telephony appear to be very promising indeed, and we owe Major Squier a large debt of gratitude for placing this fundamentally new mode of telephony absolutely at the disposal of the public without the exaction of royalty or license.

It was the invention of the seismograph for the study of earthquakes that led to the discovery of the astonishing sensitiveness of the crust of the globe to forces that might have been thought too insignificant to cause distortion. Among these forces is the alteration in the pressure of the atmosphere during the passage of storms, causing a perceptible tilting of large areas of ground. A curious case of such tilting has been recorded in Japan. A storm passing over the sea east of Tokyo caused the bordering land to tilt downward, notwithstanding the fact that atmospheric pressure is lessened within a storm area. This is explained by the fact that the sea rises with release of atmospheric pressure, and the accumulation of water more than sufficed to counterbalance the decrease in weight of the air.

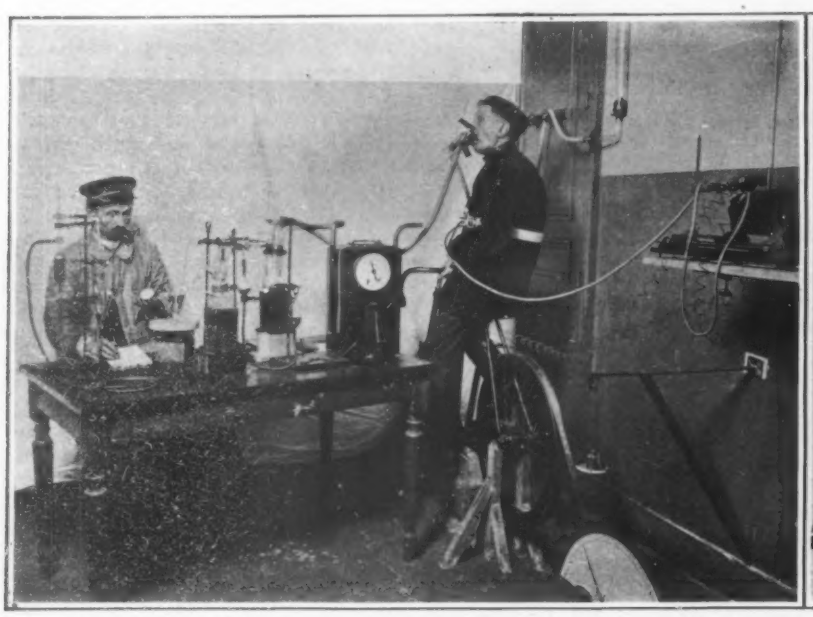
Varnished Drawing Paper for Geometers.—The paper must be coated, on one side, 4 to 5 times, with thin solution of shellac in spirits of wine and then coated three times with a varnish composed of 1 part asphalt, 8 linseed oil varnish and 2 fat copal varnish.

The Man-Machine

The Remarkable Perfection of the Human System as a Mechanism

By John B. Huber, A.M., M.D.

PROF. JULES AMAR has reported to the Academy of Sciences in Paris a study of the human machine, made on the principle that a man who eats liberally ought to recuperate in weight every twenty-four hours. If his weight lessens he works to excess; if, on the other hand, his weight increases, he has not expended the maximum effort. Hundreds of measurements, covering a considerable period, convinced Amar that the human machine gives a profit of 25 to 30 per cent on the expenditure; but that the best artificial machine returns only 14 per cent.



Experimental bicycle for measuring the work done by the rider.

Apparatus for collecting and sampling expired gases.

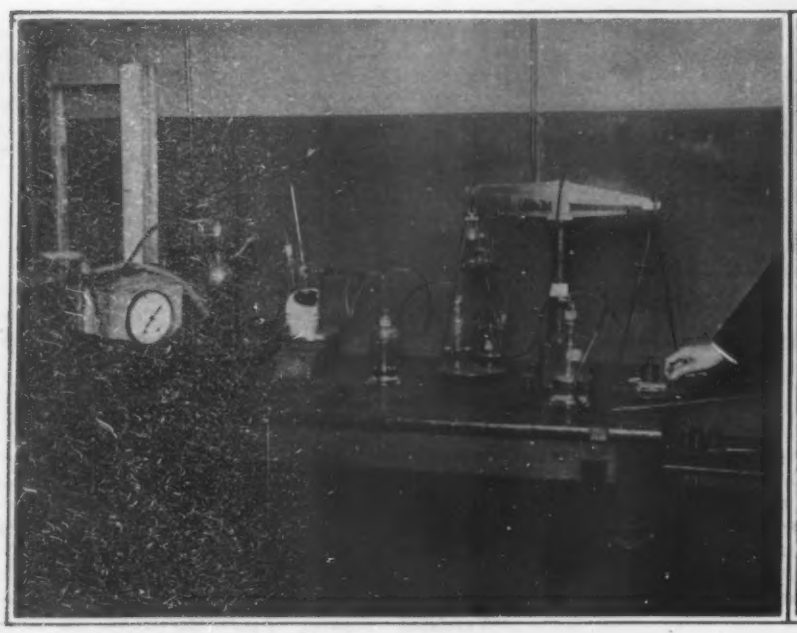
Man is superior to all mechanisms. Weston, in the most recent of his feats, demonstrated above all things else (in so far as an individual could) that the human organism is not only the greatest psychic entity on earth, but also that this superlative mind is housed in the most capable and serviceable machine that breathes and uses muscles. The *genus homo* has had to drop the mediæval assumption that the cosmos exists for its especial behest; although we may some day do a thing or two to Mars. But unquestionably this planet is anthropocentric; and man stands forth in greater dignity, and certainly in greater power, the more he disregards props and irrelevancies. There has well been found something of primitive defiance in such achievements as those of Weston; as if an elder generation looked with scorn upon the toys of its puerile descendants. "See what man can do without any of your motors, or airships, or eighteen-hour trains;" see in the man of nature "how the news was brought to Marathon, and Hannibal crossed the Alps, and the relief came to Lucknow." *The Autocrat of the Breakfast Table* observed that "the nation which shortens its swords increases its boundaries;" nor has modern ingenuity ever invented a deadlier weapon than the short sword of the Roman—the most destructive of all weapons—because the man wielding it has the courage and stamina to get sufficiently close to the enemy to drive it in up to the hilt. It was not chiefly the sword; it was the *man with* the sword.

Suppose to-day a good horse, a good automobile, and a real man were to start from the East for San Francisco. The first two would no doubt disappear before the latter had reached a milepost; but the man would most likely, somewhere this side the Mississippi, come upon the horse laid up in a boarding stable; and upon the motor towed to a repair shop with a wrenched axle. In a race for a month or a year man need not ask a handicap from any other vertebrate; nor has he ever devised a machine which can get him over obstacles and transport him without varied conditions so surely, safely, and comfortably as will his own legs.

To return to Amar: He found that soldiers ought to be able to march thirty-five kilometers (twenty-one miles) a day at the rate of five and one-half kilometers (three and one-third miles) an hour, carrying forty-five kilogrammes (ninety-nine pounds). Negroes, studied by him in Algeria, show superior resistance, but less intensity, than white men. Though man is superior to all mechanisms, especially in delicacy, he, however, always wastes energy during the first five minutes of work, before regaining his equilibrium. Monday's human labor, moreover, is the most inferior and Tuesday's the most superior, owing to the curious action of Sunday as a rest day. The Monday lassitude of the French workman is proverbial; and no doubt he is not alone in this phenomenon.

But what is fatigue? This question has been excellently considered in Harpers' Magazine: Fatigue is the cry of the builders for more material, when the supply has given out, by reason of excess of effort. Every muscular effort is a chemical process manifested by heat, which results in perspiration and the sensation of warmth on exertion. All combustion, either within the sentient body, or in nature outside of it, is a chemical combination of the atmospheric oxygen with other elements of the substance consumed—coal, gas, or animal tissue. In muscle contraction there is combustion—a combination of the oxygen in the blood, with stored-up material (glycogen) in the muscle; and thus is produced the bodily heat. Shivering in cold weather is a reflex, by which the body supplies itself with heat through combustion in the muscle. Normally the body temperature in man and warm-blooded animals is kept automatically at a constant level favorable to the chemistry of life processes; this temperature is in fact due to these processes. At times this automatic heat regulation fails; then result numbness and in-

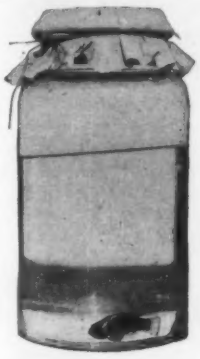
(*Continued on page 72.*)



Comparative experiment with a guinea pig.

The Amar gas-analysis apparatus.

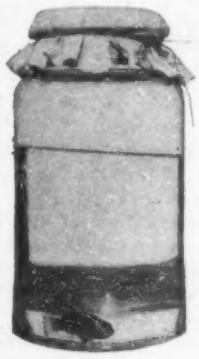
THE MAN-MACHINE



Transporting Living Animals with the Aid of Oxygen

Specimens Shipped from New York to Germany

By Dr. Raymond C. Osburn, Assistant Director of the New York Aquarium



A VERY interesting experiment in the transportation of aquarium specimens has recently been made by Mr. Emil Gundelach of Gehlberg, Germany, with the assistance of the New York Aquarium. Arrangements were made for the shipment of living specimens from the Aquarium to Mr. Gundelach's home in Germany, in the following manner:

Sixteen 3-liter glass jars were filled with water, and the specimens introduced. The jars were then inverted under water, as in a pneumatic trough, and oxygen gas introduced to replace the water until the jars were about one-third full of the oxygen. The jars were then tightly corked, and covered with parchment to prevent any escape of the gas. They were packed in crates and shipped at once on the North German Lloyd steamer "Kaiser Wilhelm der Grosse" on the morning of September 13th.

The list of specimens put up by the Aquarium for this experiment was as follows:

Common sunfish (*Eupomotis gibbosus*), in fresh water.

Variegated minnow (*Cyprinodon variegatus*).

Cunner (*Tautogolabrus adspersus*).

Beau Gregory *Eupomacentrus leucostictus*).

Star corals (*Astrangia danae*).

Sea anemones (species undetermined).

Tunicates (*Molgula manhattensis*).

Common shrimps (*Crangon vulgaris*).

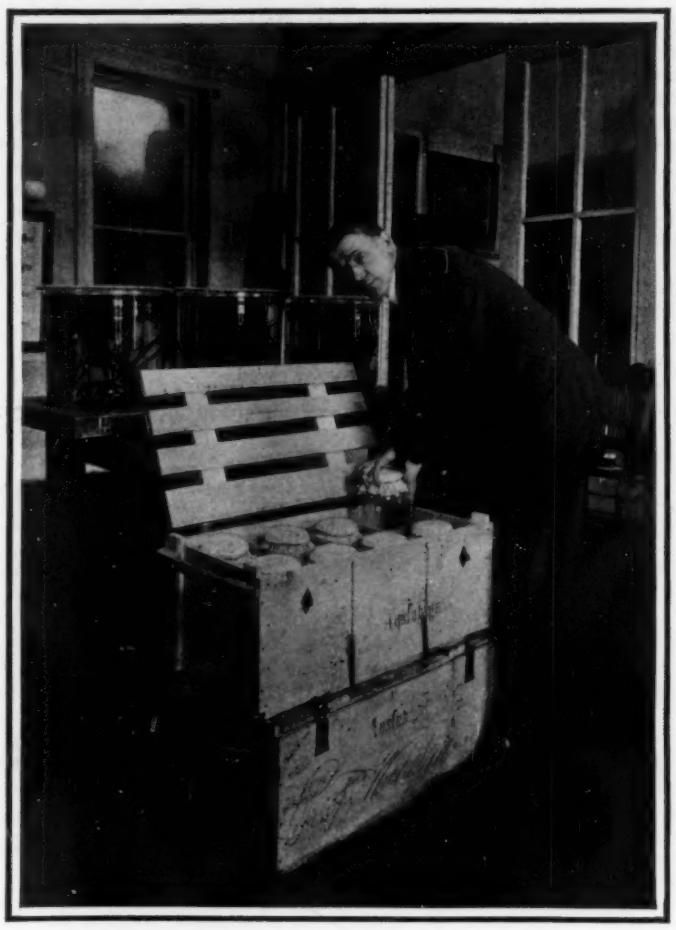
Horseshoe crabs (*Limulus polyphemus*) a couple of dozen of young just hatched, and one so large that it could not straighten out in the jar.

Fiddler crabs (*Uca pugnax*), several specimens in wet sand with an atmosphere of oxygen.

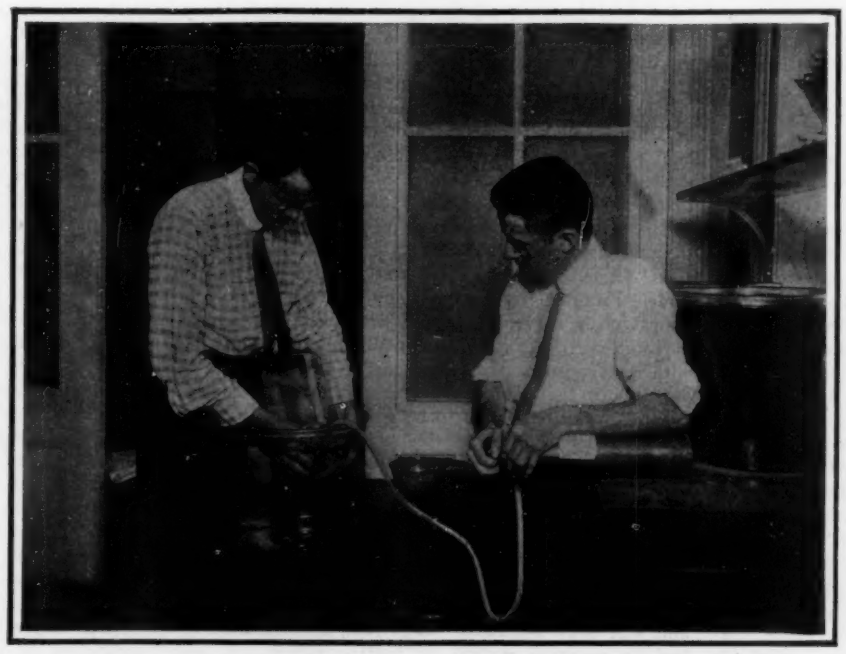
This widely varied selection was purposely made by me to test the possibilities of the experiment.

An extract from Mr. Gundelach's letter of September 25th, acknowledging the receipt of the specimens, shows what success was met with. "The collection arrived at Gehlberg on the evening of September 22nd. Notwithstanding the length of time (over nine days) the specimens reached my home in safety. The Beau Gregory and the Cunner got chilled because the temperature was too low, and both of these fishes died the next day, but all the other specimens live and are in the best of condition. It is very important that the experiment has succeeded, and you can now exchange any specimens with any European institutions in this way."

In order to know what losses, if any, might be laid to temperature, Mr. Albers, second officer of the ship, kindly consented to make daily records of the temperature of the room in which the crates were placed, throughout the voyage. His report indicates a gradual decrease from 73 to 66 deg. F., and Mr. Gundelach informs me in his letter that it was as low as 63 in Germany at the time the specimens arrived there. The Beau Gregory, being a tropical fish, evidently did succumb to the cold, but the Cunner is a northern form, and the same explanation will not apply. The specimen was probably too large for the jar and the supply of oxygen. It was the largest fish sent, and was selected to test the size limit. It did not, however, suffocate during shipment, but it was probably weakened by confinement for so long a time in its very narrow quarters, and possibly the oxygen supply ran a little short. Of course, the journey was made entirely without food. Mr. Gundelach had previously made successful experiments in shipping for the shorter distances in Europe, but nothing paralleling the present experiment has thus far been undertaken. The particular advantage in this method is that specimens can be sent apparently any distance without any care whatever during transit, thus doing away entirely with the expense of an attendant or any special machinery for aerating the water.



Packing the specimens in crates after treating with oxygen.



Partly filling the jars with oxygen, using the pneumatic trough.

TRANSPORTING LIVING ANIMALS WITH THE AID OF OXYGEN

SINCE 1892, when Prof. John Muirhead Macfarlane (now director of the botanical garden at the University of Pennsylvania) found that the leaves of the Venus' Fly Trap will close up only if the trigger-hairs are disturbed twice in succession, very little has been learned about the physiology of this curious insect-catching plant. During the past year, however, some new experiments have been made that bring the behavior of this plant into line with the behavior of animals in certain respects.

The leaves are sensitive to mechanical disturbances, to electrical stimulation, and to the sudden increase in temperature as through the application of warm water. At ordinary temperatures, it takes two stimulations to set up the response; but at higher temperatures—35 deg. to 40 deg. C.—one "shock" will cause the leaf to close. At ordinary temperatures, one electric shock will produce the effect if it is strong enough. In applying electrical stimulation it was found that the leaves were much more sensitive to the opening of the circuit than to the closing. The most interesting results were obtained in experiments with "subliminal" stimulations, that is, shocks that were below the limit of intensity necessary to secure reactions. Here it was found that the plants may respond to a summation of stimuli. In the case of electric shocks, intervals of fifteen seconds still permitted a summation of effects of very slight disturbances; while with mechanical disturbances the effects were still more persistent. For example, two to five very delicate disturbances of the trigger-hairs at intervals of one minute produced the same effect as two ordinary disturbances at a very short interval; when the intervals were increased to two minutes, it took from five to seven stimuli to bring about the closing; when the intervals were three minutes, it needed six to nine stimuli. On the other hand, if the intervals were too short, there was no response. At ordinary temperatures, the two stimuli must be at least three-fourths of a second apart; at 35 deg. to 40 deg. not less than one-fourth of a second. This is exactly like the condition found in the muscles of animals, where there is a short period following a stimulation, during which a subsequent stimulation produces no effect whatever.

On carrying out the well-known experiment of passing steam through a mantle surrounding a barometer tube containing a small quantity of water, Mr. F. R. Watson found that after a certain amount of depression of mercury had taken place the latter began to oscillate about a point corresponding to the line of condensed steam in the mantle. During the oscillations the mercury continued to descend as the line of condensed steam descended. The experimenter explains the phenomenon on the same basis as Griffiths explained the action of a hot-air engine. The mercury goes through a complete cycle during each oscillation, absorbing heat at steam temperature, and giving it out to the cold tube lower down. It becomes cooled also by the work it does in expanding. It is then pushed back up the tube from below, its pressure being less than when expanding, because its temperature is less. Therefore more work is done during expansion than contraction.

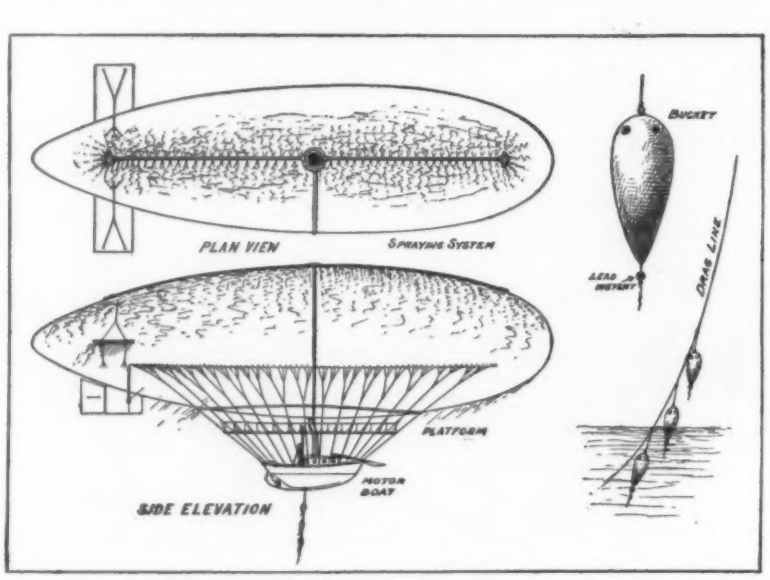
The Brucker Transatlantic Airship Expedition

By Carl Dienstbach

IT was during the closing years of the nineteenth century, directly before Santos-Dumont, Count Zeppelin, and the Lebaudy brothers demonstrated the practicability of the motor-driven balloon, that the boom of the time-honored drifting spherical balloon was at its highest.

The use of improved material and new methods of navigation, based on the teachings of meteorology, provoked such feats as Count de la Vaulx's still unsurpassed record flight from France across Germany, far into Russia, and such ambitious enterprises as Andre's ill-fated ascent from Spitzbergen in quest of the north pole, and again Count de la Vaulx's attempts to cross from Marseilles over the Mediterranean to Algeria.

It was at this period that some of the leading scientists and engineers in France became interested in the plan of sending a balloon drifting with the trade winds from Africa to America. This idea was, of course, not new. America's greatest poet, Edgar Allan Poe, suggested it in a novel which anticipated H. G. Wells in graphic realism, and in France it had been proposed in all seriousness even previous to this. For a number of years the suggestion had loomed up from time to time in the press of both hemispheres. Yet nothing ever came of the two French projects. Then the dirigible airship sprang into being, opening another avenue to the spirit of aeronautical enterprise, and temporarily relegating to the background the all-important art of navigating the air with the assistance of meteorological forces. The drifting balloon had perforce turned the efforts of aeronauts into this direction. The airship, on the contrary, at first caused the entire neglect of this field. It was the idea of the first "aerial motorists" that the wind was there to be fought. They wanted to drive through the air as an automobile is driven over the patient roadway in any direction and at any time, according to their own sweet will. Indeed, the early airships had such a short radius of action, both as regards length and height of flight, that their pilots made a virtue of necessity in heading straight into the wind for a goal which they had no time to reach by tacks and byways. Lack of lifting power prevented them from rising in search of a more favorable current, as had been the practice of the spherical balloons. The only remedy suggested for the difficulties encountered was increased speed. Count Zeppelin alone made it his first aim to increase the radius of action, since in this way he thought an airship might be made to "outlast" a storm.



The spraying system and bucket line of the "Suchard."

To Walter Wellman, the American, belongs the merit of having been the first to attempt the construction of the motor-driven "improved spherical" balloon; giving it a greatly increased radius of action. His proposed flight to the north pole could hardly have succeeded without more preliminaries than his limited means enabled him to undertake. His attempt to cross the Atlantic from west to east in the temperate zone with substantially the same airship that had been designed primarily for the materially different purpose of an Arctic expedition, was "experimental" in a dangerous degree. Credit must, however, be given to him for sacrificing his craft in the first endeavor to put fascinating theories of world-wide airship travel into practice. But Wellman's ocean-crossing dream had been anticipated in Germany on the initiative of a German-American, Joseph Brucker. Whether Brucker's plan meets with complete success or not, it will represent a new milestone in the history of aerial navigation. It will revive the old French idea of crossing the ocean with a balloon, modified, however, to this extent, that the craft employed will be a motor-driven airship representing the very latest product of the German aerial dockyards.

Mr. Brucker owes the realization of his plan to the great aeronautical exhibition held during the summer of 1909 at Frankfort-on-the-Main, Germany, during which he met in conference with the assembled meteorologists, aeronauts, and "aerial architects." The moving spirit of the exposition, Dr. Ganz, a noted scientist, aeronaut, and sportsman, saw chances of success in Brucker's plan. He became director and consulting engineer of a company founded to realize the enterprise. In April, 1910, the company received its charter under the name "Transatlantische Flug Expedition" (Transatlantic Airship Expedition), with a board of directors comprising some of the foremost scientific and commercial leaders of Germany. Mr. Brucker himself holds the office of manager. Dr. Ganz, the president, subscribed a considerable amount, but the well-known Swiss firm Suchard has guaranteed to meet most of the expenses. The airship is accordingly named "Suchard." Many months were spent by Dr. Ganz and Mr. Brucker, together with the consulting engineer Mueller-Peissenberg, in computing the form and size of the vessel, especially the equipment of the car. This car is designed in the form of a seaworthy motor boat. It is worthy of notice that such famous persons as Prof. Hann of Vienna and Dr. Koeppen of Berlin have given their enthusiastic indorsement to the enterprise.

The balloon was built by Mr. Riedinger in Augsburg, and the boat at the boat yards of F. Luerssen in Aumund-Vegesak. The balloon is of the type of the big "Parseval VI.," but is of a modified pattern. It is sturdier, 60.5 meters long and 17.2 meters in maximum diameter. The greatest width is situated at the first third of the total length, as is typical of Prof. Prandtl's Parseval-shape. The stern is sharply pointed, the bow egg-shaped. The envelope has a body of 9,400 cubic meters. The ballonet is very large, comprising more than one-third of the entire volume; it measures 3,500 cubic meters, which is equal to the total displacement of a typical French airship. This insures a rigid hull, even after very extensive loss of gas, and enables the ship to contend with the most extreme conditions that are likely to arise in the course of a long voyage. The designers of the "Suchard" centered their efforts upon the production of a craft which should not only have tremendous radius of action, but should at the same time offer the highest attainable degree of safety. Both of these requirements could be realized in building a ship of ample size designed for low speed. The weight saved in machinery could thus be applied in making a thoroughly strong structure, and in equipping the airship with proper safety appliances. The envelope is made of a special fabric manufactured by Metzeler of Munich, with three layers of cloth, two of rubber, and a light rubber coat on both surfaces. This, together with the large volume and the ratio of four to one between length and diameter (resulting in a comparatively small surface per unit volume) seems to guarantee excellent gas-retaining qualities. Even the "Zeppelin VI.," which was burned at Baden-Baden, retained its gas for many weeks at a time in almost daily service. In the "Suchard," gas loss by diffusion will be absolutely negligible as compared with gas escaping when the safety valves are operated under the influence of the heat of the tropical sun. This latter loss is to be reduced to a minimum by a special patented device, which is perhaps the most important feature in the entire design of the airship. No balloon built hitherto has had anything like the endurance which the "Suchard" will have, and it is for this reason that even with the best spherical balloon, crossing the ocean was, up to the present, an impossibility. The "Suchard" will profit by the fact that its route will be entirely over water, and will draw advantage therefrom, as explained below, to properly control its floating power. It will have to combat conditions infinitely more inimical than those ordinarily met with by airships now in use. When we consider that it will have to undergo the extreme change from night to tropical day over water from five to seven times, it appears at first sight as if the whole enterprise were simply foolhardy. Even a single change from night to day causes most serious difficulties to ordinary airships on land. The plan which the designers of the "Suchard" have formed to meet these difficulties certainly appears founded on good common sense. It remains to be seen whether the technical execution of the device as it stands now will prove capable of realizing what is expected from it. It seems probable that the proper manipulation of the apparatus will require great skill and much practice. The plan is to scoop water as ballast, whenever needed, with scoops or buckets carried on the end of a steel cable. These buckets are made of sheet steel, of a shape designed to cause the minimum amount of drag while filling. Each holds 25 liters, and has four holes in front to admit the water to enter. Three or four of these buckets are attached by means of short lines to a wire cable, of one centimeter diameter. They fill automatically and rapidly in consequence of the motion of the ship. Although they can simply be dropped into the water, so that the action takes place immediately, the effect of the sun's rays also is very sudden, and it would not be safe to depend on this device alone. It is supplemented by a movable weight, which regulates the inclination of the keel. By the aid of this arrangement, a certain amount of lifting or downward force can be called forth by aeroplane action through the motion of the ship. But the most important feature is an original device for cooling the envelope with running water. Light watertight canvas hose extends from the boat to the top of the balloon, where it encircles the gas valve, and then extends backward along the balloon. This tube is provided with a large number of perforations along its sides, and ends in a hard rubber spray nozzle fore and aft.

From a tank in the boat water is pumped through the hose and, issuing from the holes and nozzles, flows in a thin film all over the envelope. The 18-mile breeze produced by the ship's motion through the air will cause rapid evaporation of this water, resulting in an intense cooling effect.

It is planned to make a number of trial trips with the "Suchard" before embarking on the actual trip with the trade wind, which allows of no return.

These trial trips may represent the weak point of the enterprise. For they will have to be made in Germany, where the weather in winter is not favorable even for airships making over 25 miles an hour. But of course such trial runs are indispensable, for the water-scooping and water-spraying apparatus will certainly require not a little skill in handling.

The impossibility of giving the operators such full and adequate preliminary experience as would be desirable in the management of their craft under the conditions of the actual trip, is in a measure compensated for by the very placid character of the waters over which they will sail.

The endurance of the motors under conditions such as prevail in the tropical seas during the early months of the year, might, on the other hand, very well be tested out in the shop.

The "Suchard" will be equipped with a regular workshop, which will be most valuable for executing any repairs to the motors that may become necessary during the trip.

In the light of Wellman's experiences, Brucker's success seems to depend essentially on his skill in handling the water-scooping and spraying apparatus, and on his ability to prevent the craft from rising unduly. If he succeeds in avoiding gas losses from this cause, then he can hardly fail to reach America, even if his motors give out.

His ballonet is so large that it should be quite able to compensate for even considerable expansion or contraction of the gas. The equilibrating apparatus appears efficient, but will require the closest attention and great skill in handling.

It should be possible to actuate the spraying pump and the water-scooping winches by hand in an emergency. For even a few minutes' failure of these devices may send the ship to the clouds, blow off great quantities of gas, and spoil all chances of a long voyage.

(*Continued on page 76.*)

Our Smokeless Cannon Powder the Best

By Hudson Maxim

THE smokeless cannon powder used by both branches of our service to-day is probably more nearly perfect than any other that has yet been produced abroad. Furthermore, it is entirely an American production. Not one iota of its form or composition was derived from any foreign source.

The four chief desiderata in a smokeless powder are:

First, that it shall be a stable compound; that it shall keep long enough for all practical purposes under varying conditions of climate and storage.

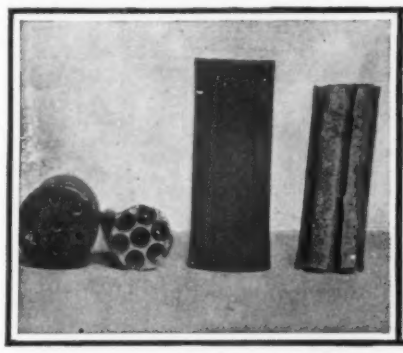
Second, that it shall produce high velocities with low chamber pressures.

Third, that it shall, for given pressures, have the minimum of erosive effect upon the bore of the gun.

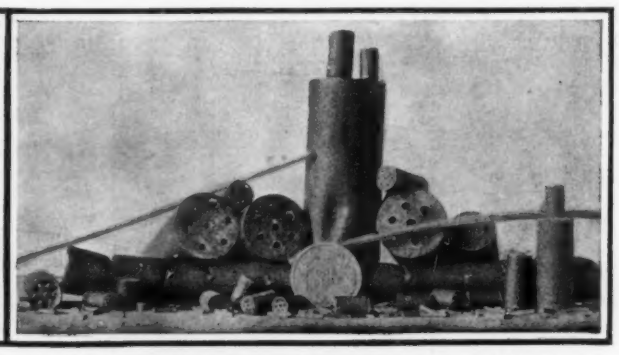
Fourth, that it shall give regular pressures, that is to say, that it shall always behave alike, giving like pressures under like conditions.

Now, the merits of foreign powders, with respect to the above four essentials, are well known both to our powder manufacturers and to the powder experts of our Army and our Navy. It has long been a source of general gratification and satisfaction that our smokeless powder is not only superior in certain respects to foreign powders, but also in each one of the above four most important respects it is decidedly superior. We are getting higher velocities, with lower chamber pressures, than are obtained by any other government in the world. There is greater regularity of chamber pressures; there is less erosive effect upon the guns; and no foreign smokeless powder equals ours in chemical stability.

The first smokeless powder to be adopted by this government was produced by myself and my assistants at Maxim, N. J., and was known as the Maxim-Schüpphaus smokeless powder. It was made in short, round cylinders, about three diameters long, these cylinders being multi-perforated longitudinally with seven small holes, by a process invented and patented by me. The powder consisted of eight per cent soluble nitrocellulose and ninety-two per cent of tri-nitrocellulose. This composition, however, was later abandoned in favor of a pure nitrocellulose colloid made by the use of ether and alcohol, with a special form of nitrocellulose developed by naval officers at the Newport torpedo station. This has been our service powder ever since. No nitroglycerin has been employed in our cannon powder during the last twelve years.



Partly consumed grains of 12-inch gun smokeless powder.



Smokeless powder of various forms and sizes to suit different calibers of naval guns.

The character of granulation for each gun, and all the steps in the processes of manufacture, and the tests for determining the chemical stability of the final product, are determined upon and supervised by government officers, whose intelligence, scientific training, and practical experience are certainly not excelled, even if equaled abroad. All results of firing in guns of all sizes are carefully and methodically tabulated for future reference and guidance.

The form of multi-perforated grains now in use was decided upon and adopted only after most exhaustive tests had been made with many other forms of granulation, including every form in use in foreign countries. Not one step is taken, either in the process of manufacture of our powder or in the size or form of grains, until it has been proven by ample experimentation. The great smokeless powder plants of the E. I. du Pont Powder Company are probably the largest, most scientifically constructed, and most intelligently and carefully operated of any in the world; and the government officers and the officers of this company co-operate in perfect harmony with the constant aim of attaining to the highest possible efficiency of manufacture and perfection of product.

No wonder, then, that our Naval Secretary Meyer and our Chief of Ordnance of the Army, Brigadier-General Crozier, should resent the extraordinary act of Sir Hiram Maxim in writing to our Bureau of Ordnance, and even to President Taft, about our powder, in a vein so preposterous as to elicit from Secretary Meyer the assertion that "his statements are unworthy of serious consideration except as to their misrepresentations and to the evil effects of their wide publicity on those unacquainted with this subject."

In Sir Hiram's letter he frequently referred to an article printed as an editorial in London Engineering. The pronouncement of Secretary Meyer may be applied equally well to the statements contained in that article as to those contained in the letter of Sir Hiram Maxim to the President. It is stated in the said article that artillery experts, both in England and in the United States, are strongly of the opinion that the accidents to some of our large guns were not due to any fault in the design or manufacture of the guns, but were due to the use of multi-perforated powder. Then follows a remarkable history of an accident which occurred in 1889 to a 10-inch gun at Sandy Hook. This history of the accident is remarkable for being an account of exactly what did not happen; just as the statement that artillery experts in this country blame our powder for the accidents that have happened to our guns is remarkable for being the exact opposite of their opinions.

The ignorance of the subject displayed by the author in the article referred to is manifested by many statements so palpably contrary to fact, that it is a wonder that anyone at this time with any experience whatsoever with smokeless powders and ordnance could be so uninformed as to make them seriously.

Take this statement, for example: "It has been repeatedly found that multiple-perforated powder will not stand the heat test." It is difficult of comprehension how anyone could think that the physical shape of the grain could have any effect whatsoever upon its chemical stability. How could the fact that a grain of powder has several holes running through it possibly render it more unstable, and thereby vitiate the heat test?

The author refers also to a detonation of the powder charge having taken place in the 10-inch gun which had its breech block blown out at Sandy Hook in 1899, and in the 12-inch gun which burst on the "Georgia." The 10-inch gun referred to simply had its breech block blown out, an accident due to faulty construction of that mechanism. Although the particular lot of powder used at that time was of faulty construction, many of the grains being porous and varying widely in size and character, and although the powder contained a small percentage of nitroglycerin, still the charge did not detonate; for, had it detonated, the entire gun around the powder chamber would have been blown into fragments; and had the powder charge detonated in the gun which exploded on the "Georgia," the same effect would have been produced.

The author of the article also refers to Sir Hiram as being the first to make a smokeless powder by combining tri-nitrocellulose and nitroglycerin, and refers to the use by Sir Hiram of castor oil in that patent as something important and useful. It is interesting, at this time, to examine Sir Hiram's record as an inventor and developer of smokeless gunpowder. He never had anything to do with the manufacture of explosives on a commercial scale, and nothing invented by him in explosives has been adopted by or employed in the service of any government in the world. His only experience with explosives was limited to a little desultory work in a small improvised laboratory at Crayford, England.

At the time of the suit of Messrs. Vickers, Sons & Maxim, referred to in the said Engineering article, it was proven that the only valid claim in Sir Hiram's patent was for the use of castor oil. It was proven that there was nothing new in combining tri-nitrocellulose with nitroglycerin to produce smokeless powder—that Nobel had made such a compound and patented it in England in 1875, in which patent he

(*Continued on page 72.*)

Move to Sell Patent Office Models

THANKS to the vigilance of Representative Bennet, of New York, another effort to sell the invaluable collection of Patent Office models has been frustrated. A clause had been inserted in the Legislative, Executive, and Judicial Appropriation bill, authorizing the superintendent of the Capitol buildings and grounds to sell within sixty days, all of the patent models now stored in the basement of the House office building. On calling up the Commissioner of Patents, the Representative found that Mr. Moore had for many years entered his most emphatic protest against any suggestion that the collection of models should be disposed of in any way. The paragraph was ruled out of the bill, and for the present at least, the collection of models will be safe.

A few years ago, a similar effort was made to get rid of the collection, but was thwarted in the Senate Committee on Appropriations. At that time, it was argued that the room occupied by the models in the Interior Department was needed for other purposes; but the collection was saved by being stored in the House office building, where the 134,000 models, classified and boxed up, are now preserved.

There are reasons, both sentimental and practical, for saving this unique collection, which includes the original models of many of the epoch-making inventions of the last century. All models prior to 1836 were burned, and but a few of them have been restored. Additional models to the number of 86,000 were destroyed in the Patent Office fire of 1877; but there is a sufficient number remaining to form a collection of indisputable value. In proof of this, it is sufficient to mention the sewing machines of Howe, Wilson, Singer, Willcox and Gibbs, and others; the Morse telegraph instruments, of 1830 to 1840; the Bell telephone, of 1876; the Edison phonograph, of 1878, and his electric lamp, bearing date 1880; the House printing telegraph, of 1846; Thurber's typewriter, of 1843; and the beautifully-built and operative models of the work of Hoe, Bullock, and Gordon in presses and the allied mechanisms. Here also is the time-clock of Savage, of 1847; the arc lamp of Collier and Baker, of 1848; and the old electric motors of Davenport, Neff, and Edison.

The practical value of these models lies in the fact that in early days, drawings and sketches were incomplete, and it was necessary to depend upon the model for the disclosure of the details. Hence the models were an indispensable part of the records of earlier patents.

The Patent Bar Association is on record as strongly in favor of the preservation of the exhibit, arguing that it is impossible to establish any standard by which to determine the relative importance of a model, and that none of the models which form part of a patent should be disposed of which can be useful as a record. The model which seems to be of the least importance to-day may, because of future developments, be of the greatest importance to-morrow. The Commissioner of Patents states that he is required, by orders from various courts during the year, to send out several hundred of these models as evidence in contested patent cases. This statement of Mr. Moore, referring to conditions which will be true for all time, should be sufficient to settle, once and for all, the question of the preservation, intact, of this valuable exhibit.

The Current Supplement

THE front page of the current SUPPLEMENT, No. 1829, shows two excellent views of Mount Sinai, the "Holy Mountain" of Bible lands. A number of other views, with an exceedingly interesting description of recent explorations in the Sinai peninsula, will be found in the body of the paper.—Dr. Victor Quittner takes up the subject of magnetic crystals, explaining their peculiar properties.—A summary of the proceedings of the annual meeting of the Geological Society of America is given by E. O. Hovey.—There is an article on the subject of power production from solar radiation, outlining the proposed plan for the commercial utilization of power from this and other intermittent sources. While the same subject is taken up on another page of this journal, the article in the SUPPLEMENT will be found to go into the matter in greater detail.—The discovery of vanadium in a brown lead ore from Zimapan, Mexico, and the subsequent history of this metal, are outlined in one of the articles.—The development of submarine boats is concluded from the previous number.

Our big game animals are constantly diminishing in numbers, and unless protected will soon disappear. The chief function of the federal government in this connection is to stimulate and co-ordinate the action of the several States and to aid in solving the protection problems as they arise.

Abstracts from Current Scientific Periodicals

In this department of the Scientific American the reader will find brief abstracts from interesting articles published in English scientific periodicals, and translations of valuable articles that appear in French, German, and other European scientific publications. The department, in other words, will be a kind of digest of current scientific information gleaned from reputable sources.

The School-Desk Question

THE first and most essential requirement of a school desk and seat is that its dimensions, in general and in detail, shall agree with those of the pupil. The average bodily proportions of school children have been determined by numerous measurements, and are known to the best-informed makers of school furniture, who are in substantial agreement concerning the height of the seat, back, and desk, the width and depth of the seat, and the inclination of the top of the desk, so that school officials need no longer trouble their heads with these matters. The question how the desks can best be adapted to the individual needs of pupils of very different absolute dimensions, and of ages ranging from six to eighteen years, has not been decided so unanimously. Universal desks can be recommended only for occasional use in special cases. The school must rely on graded desks, and of these the desks of fixed dimensions are preferable to adjustable desks. If adjustable graded desks were used the exchange of individual desks would be unnecessary, but there is little reason to believe that the desks would be adjusted more carefully or correctly than desks of fixed dimensions are now distributed and exchanged. In very small schools, however, where the fluctuations in the relative numbers of pupils of various sizes cannot, perhaps, be provided for with desks of fixed dimensions, without keeping on hand a reserve supply of desks of each size, it would be advantageous to substitute adjustable desks, or, better, to employ a limited number of them in conjunction with desks of fixed sizes of the same type of construction.

Dismissing all the foolish schemes, Dr. Koppin in

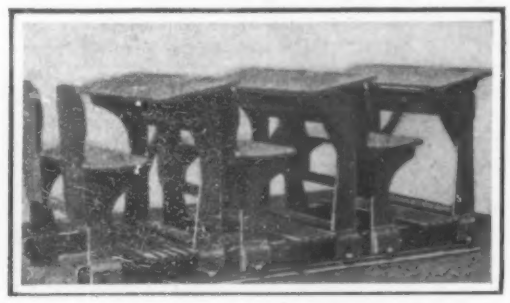


Fig. 1.—The Rettig desk and seat. Movable as a whole on rails and without moving parts.

Umschau states that the other requirements demanded by hygienic, pedagogic, and economic considerations may be expressed as follows: The desk must permit the pupil to maintain a hygienically correct attitude in reading, writing, listening, and all school work; give sufficient room and freedom of movement; afford the most suitable angle of vision; protect the feet from cold and dampness; be easily removable in order to permit thorough cleaning of the floor; have all movable parts designed to work without noise or injury to the pupil; economize floor space; present a good appearance; and, finally, be cheap and durable.

This formidable list of theoretical requirements, in conjunction with the now practically decided question of dimensions, has stimulated German inventors and manufacturers and led to the development of more than two hundred "systems," each of which has found, in addition to persons financially interested in its adoption, many disinterested advocates. The most successful of these devices are certain swinging seats and hinged, sliding, or swinging desks. The principal advantage of some of these contrivances was that they facilitated transit between the long benches and desks that were formerly in vogue, but the obvious objections to the presence of movable parts and the necessity of exchanging desks gradually led to the adoption of desks accommodating only two pupils, while the increasing demand for clean floors led to the construction of desks movable on rollers or sliding on rails, like the Rettig desk (Fig. 1). A more recent type is the Midrib desk (Fig. 2), in which the seat and the desk are connected, not by two lateral sills, as in the older forms, but by a single beam, placed above the seat and between the two occupants, and the combined desk and seat stands on four small feet. In facilitating the cleaning of the floor this construction is superior to desks with sills, but inferior to the Rettig desk.

This historical sketch shows that experience has proved—though no proof was needed—that the theoretical requirements stated above are not entirely compatible with each other, so that no single construction can satisfy them all. Hence each system must be judged by the algebraic sum of its merits and demerits, but this sum cannot be expressed with mathematical exactness.

Furthermore, the problem is not completely solved, even in theory. One of the open questions relates to the distance between the desk and the back of the

Fig. 2.—Midrib desk and seat with sliding desk top.

seat. Most, though not all, hygienists insist that this distance should be variable; but school authorities, with few exceptions, will have nothing to do with movable parts, and no convincing proof of the orthopedic or hygienic necessity of using movable backs has yet been produced. Of greater hygienic importance is the shape of the back. Theorists had almost united in recommending a shape agreeing with the natural curvature of the erect spine when Schulthess discovered that the concavity of the lower part of the spine is, in children at all events, peculiar to the standing posture. Whether a foot rest is a desirable addition or not is also open to question. These two important points should be decided without delay.

In view of these and other controversies, the practical rules for the construction of school desks and seats must, for the present, be limited to the following: 1. The desk must be designed for not more than two pupils. 2. Each bench must have its own back and must form a constructive whole with the desk *in front* of it. 3. The distance between the back of the seat and the edge of the desk must be such that the pupil is supported, in an erect and comfortable position, in reading, writing, and hearing lectures. 4. Movable parts, if present, must be few in number and sure, nearly noiseless, and perfectly safe in operation. 5. The desk and seat must either be destitute of sills or easily movable, as a whole, in order to permit thorough cleaning of the floor.

The second rule is based upon the necessity of exchanging desks in accordance with the fluctuating proportions of large and small pupils in successive classes, and the consequent necessity of making each desk and its seat independent of the others. The American or "intermediate" system, and all others in which each desk forms the back of the seat in front of it, are excluded by this rule.

It is not sufficient, however, to furnish a school with the best desks that can be procured. It is also necessary to make sure that the desks are arranged in the best possible manner in regard to illumination and efficiency of school work, and that every pupil always has a desk and seat of a size corresponding with his stature.

Fig. 3.—American or intermediate system. Also an example of excessive distance between desk and back of seat.

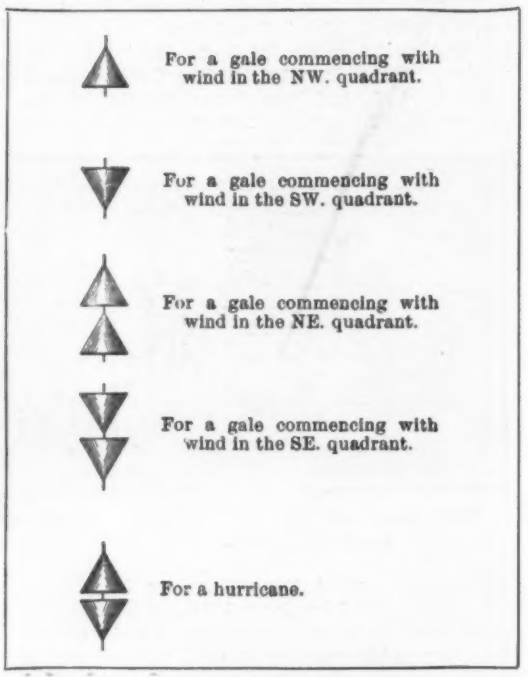
International Storm Signals

THE International Meteorological Committee, at its meeting in Berlin in September, agreed, after considerable discussion, to accept, for international use, the system of daytime storm signals shown in the accompanying diagram. The symbols consist of large cones, such as are already used for this purpose in several European countries; they are usually made of tarred canvas. The cone displayed at English seaports is three feet high by three feet broad at the base. The signals adopted by the committee were proposed by Prof. Moore, Chief of the United States Weather Bureau.

More than a score of different systems of storm signals are now used in various parts of the world, to the great confusion of mariners. However, as some of the official meteorological services consider that their own signals present special advantages, it is understood that these may be retained for the benefit of local shipping, wherever desired. It is, nevertheless, gratifying to know that an international code has been officially adopted, and it appears likely that its use will ultimately become universal.

It should be stated that these new signals are not yet actually used in any country, and the change from the existing signals can only be made gradually, as it will involve great expense. For instance, hundreds of signal stations of the United States Weather Bureau now use, as a storm signal, a red flag with a black center, with which red and white pennants are displayed to denote, respectively, easterly and westerly winds.

The committee was unable to agree on the combinations of lanterns to be used for night storm signals,



International storm signals.

and this question has been referred, for further discussion, to the International Commission on Maritime Meteorology and Storm Signals.

The Diet of Athletes and Wrestlers

FEW questions have been more hotly disputed than that of the proper diet of man. Recent investigations indicate that the diet should vary, according to climate, race, and occupation, but Dr. Siebert, who writes in Umschau on the subject, is inclined to go still further, and to assert, as a conclusion drawn from fifteen years' observation of athletes and wrestlers, that every man needs his own peculiar diet. He is convinced that psychical influences play an important part in nutrition.

"One of the strongest men I ever knew," Dr. Siebert states, "was the famous wrestler Ernst Reiter, known professionally as Ernst Siegfried. This young man came to me at the age of twenty, and trained three months in my establishment. His height was 6 feet 1½ inches, and his weight 191 pounds. He was very thin and his bones were surprisingly large. He trained very diligently and increased greatly in strength. His diet, selected by himself, consisted chiefly of vegetables, bread, and milk, with little meat, and his appetite was good, but not enormous. Unfortunately, I did not weigh his food. His evening meal consisted usually of less than two pints of sour milk with a little sugar, bread, and butter. On this diet Siegfried developed a degree of strength in the hands, legs, and back that I have never seen equaled, and that put him in the very first rank of wrestlers, although he was not distinguished by great skill or quickness of movement.

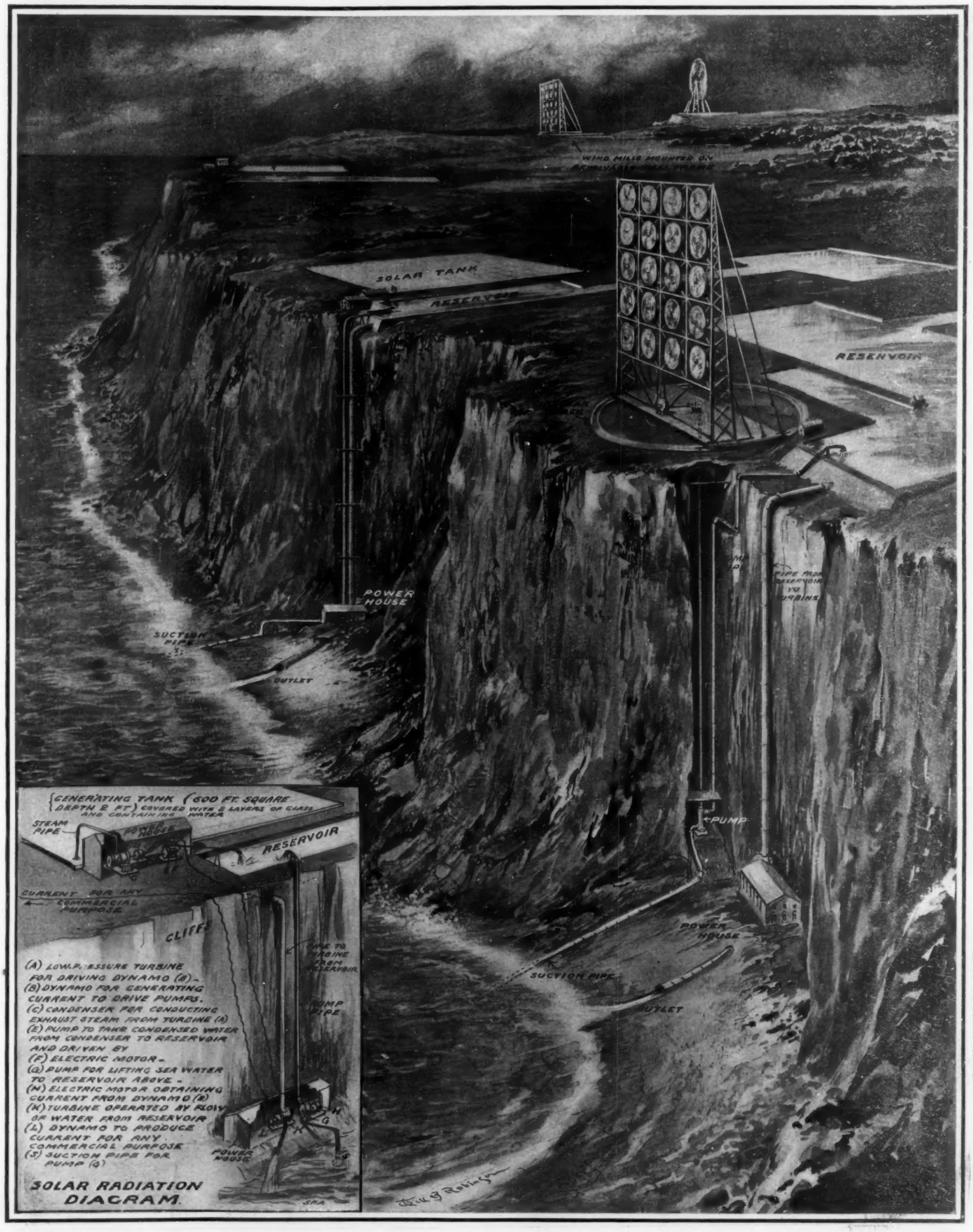
(Continued on page 76.)

The Commercial Utilization of Solar Radiation and Wind Power

While there can be no doubting the importance of the problem here discussed, it must be admitted that the difficulties in the way of its solution seem still very great. Whereas Fessenden assumes that water can be raised by the sun's rays to its boiling point, the highest temperature so reached which is mentioned in scientific literature within our knowledge is 65 deg. C., or 149 deg. F.

IT is a well-known fact that practically all the energy in the service of man is ultimately referable to the sun's rays. In particular is this true of coal, the fossilized remains of a former vegetation, which in ages past grew upon the face of the earth under the light of the sun. We have found it convenient hitherto to turn to this stored-up energy of past geological epochs, rather than to utilize directly the

(*Continued on page 76.*)



By courtesy of the Illustrated London News.

GENERAL VIEW OF A PLANT FOR UTILIZING SOLAR RADIATION AND WIND-POWER ON THE FESSENDEN SYSTEM

The Real Cause of Hoxsey's Death

Interesting Speculations Advancing a New Theory

IN presenting to our readers a photograph of Archie Hoxsey in his Wright biplane taken just before the machine struck the ground at Los Angeles on December 31st, we wish to give some information on the probable cause of this accident which, as related in our last issue, resulted in the demolishment of the aeroplane and the instant death of the aviator.

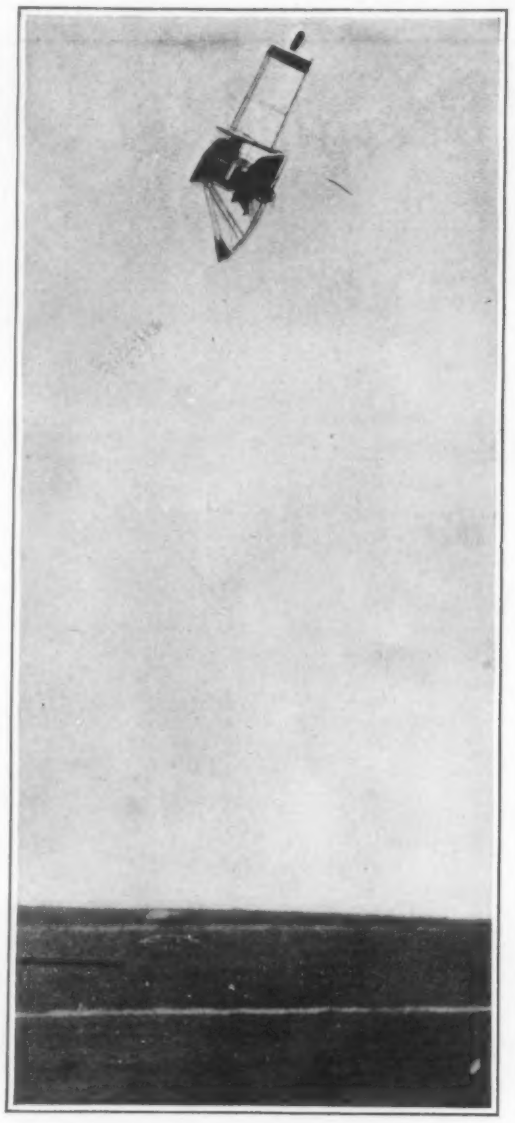
The photograph shows the machine descending at a very sharp angle in its last dive of 560 feet. Hoxsey descended from a height of over 7,000 feet in less than three minutes, and it is our belief that this rapid descent, which was at first voluntary, caused the aviator to be attacked by a form of mountain sickness such as was experienced by Morane and by Drexel under similar circumstances. This sickness may have caused Hoxsey to become unconscious, and the weight of his body upon the levers may have moved them sufficiently to make the machine dive at a much steeper angle until it finally struck the ground.

Hubert Latham, the well-known pilot of the Antoinette monoplane, is of the opinion that the mountain sickness just described was the cause of Hoxsey's death. Morane told Latham that when he was stricken by an attack of this illness as a result of making too rapid a descent, he lost control of his machine completely and was saved only by a miracle.

The sickness consists of a nauseated feeling accompanied by a swimming sensation in the head and, perhaps, a lapse into unconsciousness. The turning of sharp circles while descending, such as was Hoxsey's wont, would also have a tendency to cause a swimming of the head and dizziness. Orville Wright has been troubled with such dizziness as a result of making numerous short turns such as Johnstone and Hoxsey were accustomed to execute.

Prof. R. Moulinier a short time ago made an interesting report on the increase in blood pressure of aviators after ascending to heights of 1,200 to 2,000 meters (3,937 to 6,561 feet). The blood pressure is invariably increased during such a flight and there is often a slight headache, together with a tendency to sleep, experienced sometimes even during the flight. In one instance before a flight the constant blood pressure in the radial artery of an aviator was found to be 9 centimeters (3.54 inches) of mercury and the maximum pressure 18 centimeters (7.08 inches) as measured on a Pachon sphygmometer; the pulse was 70. After a twenty-five-minute flight, during which, at the twentieth minute, a height of 1,100 meters (3,609 feet) was reached, the constant pressure was 12 centimeters (4.72 inches) of mercury and the maximum 19 (7.48 inches); the pulse had risen to 80. The aviators in this case were athletes in full training. The rise in pressure was less marked in aviators who were fatigued, but these showed palpitation of the heart and marked acceleration of the pulse (108). In one case of an aviator who, during a flight of an hour, had reached a height of 1,000 meters, tachycardia was manifested. This heart trouble is caused by functional insufficiency of the heart and vertiginous movements. No rise in blood pressure was noted in aviators who flew at low altitudes not exceeding 500 feet. The cause of the rise in blood pressure, according to Prof. Moulinier, was probably due to the sudden descent to earth in four or five minutes from heights of from 1,000 to 2,000 meters (3,280 to 6,560 feet) or, in other words, in one-fourth or one-fifth the time required in ascending. At 2,000 meters elevation the atmospheric pressure is 591 millimeters (23.3 inches) of mercury as against 760 millimeters (29.9 inches) at sea level. The circulatory system does not have time to become adapted to the change of pressure when a swift descent is made. Prof. Moulinier also calls attention to the dangerous fatigue of the circulatory apparatus caused by high flying, which provokes increased and irregular activity of the heart especially. A sound heart and supple arteries are absolutely necessary if high flying is to be indulged in.

While it is generally conceded that safety lies in height because, in case of an accident, the aviator has time in which to again get control of his machine, the fact remains that a sudden plunge from a height of several thousand feet is liable to strike the aviator helpless if not unconscious, and therefore to seal his doom. In this connection we have but to recall the death of Maloney in California in 1905. This pioneer aviator fell several thousand feet in the Montgomery glider, and an examination of his body showed no broken bones or bruises sufficient to have caused death. The doctors gave it as their opinion that Maloney was stricken with heart failure and died during his descent, which, however, was by no means as swift as that of Hoxsey.



Hoxsey plunging to his death at Los Angeles.

THE REAL CAUSE OF HOXSEY'S DEATH

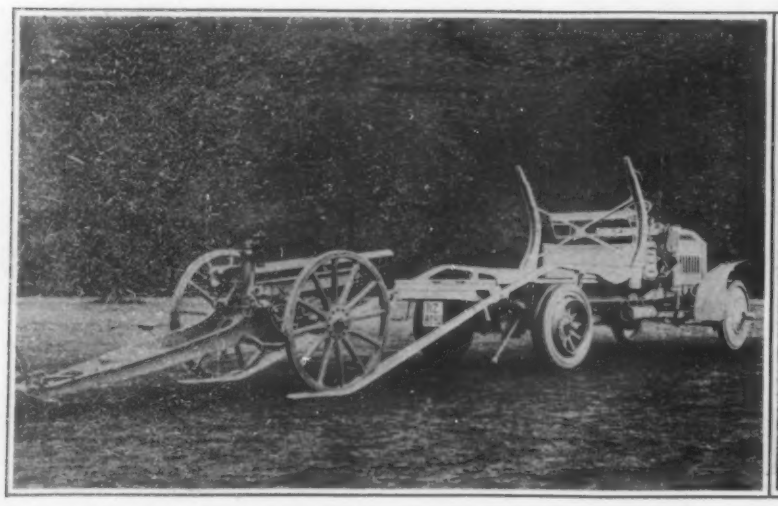
The lesson to be learned from the deaths of Johnstone and Hoxsey, both of whom fell some 500 feet, is that inventors should strive to perfect some system of automatic stability that will make it impossible for an aeroplane to dive to earth at a dangerous angle should anything go wrong about the machine, or should the aviator become stricken while in flight. Pending this each aviator who intends to do high flying should carry a parachute, or wear a parachute garment such as was illustrated in a recent issue of the SCIENTIFIC AMERICAN, so that in case the aeroplane became unmanageable he could jump or tumble out and descend to earth in safety. Where the machine is not flown higher than 250 feet, it is best to be strapped in, as in flying near the ground the most trouble is liable to come from collisions or short dives from which the aviator stands a better chance of emerging uninjured if he cannot be flung out when the crash comes, or even before, as was Moisant on December 31st near New Orleans. In a much worse smash at Belmont Park he was uninjured, while at New Orleans he was killed by being pitched out of the machine and falling only 40 or 50 feet.

Automobiles for Transporting Airship Guns

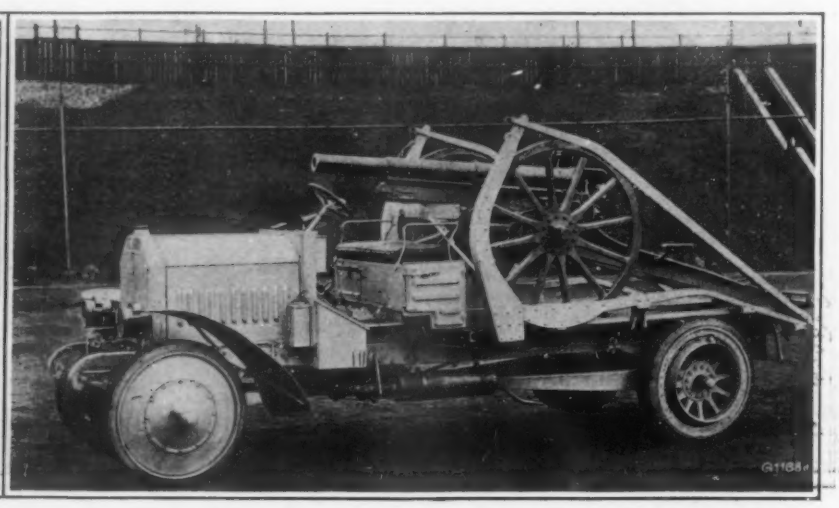
OUR two illustrations at the bottom of this page show a new automobile especially constructed for the rapid transportation of one of the new guns lately brought out by the Krupp firm for shooting at airships. Besides aiming the gun vertically, it has been found necessary to transport it quickly from point to point, in order to locate it in a favorable position for attack upon aerial craft. A special automobile truck having solid tires and armored disk wheels in front has been devised for this purpose. Special folding skids make it possible to run the gun up on the auto truck in the manner shown. The skids then fold over the wheels and are locked into place. The gun is thus firmly mounted upon the automobile, which can be driven to the desired point of attack. The auto truck used is a powerful one. It has twin solid tires in the rear, in order to accommodate the heavy gun. There is also a triangular running gear below the main frame of the truck. On account of its powerful motor, this truck can be driven across open country and over the worst of roads. On a good road it can make fairly rapid speed.

The Krupp airship guns have been illustrated and described heretofore in both the SCIENTIFIC AMERICAN and the SUPPLEMENT. We refer our readers to these earlier articles for a complete description of the guns and their uses.

The Canadian Minister of Railways recently announced that the construction of the Hudson Bay Railway will be begun by the Government at once. The first work that will be given out is the bridge that is really the beginning of the road, which is to start from the Pas Mission, to which point the Canadian Northern has already built. It is not yet decided whether the mouth of the Nelson or the Churchill will be the northern terminus of the road, and a steamer carrying a location party will be sent north this summer to make a choice of the terminal point. In the meantime the construction of 160 miles of the road can be pushed on, irrespective of the terminus. It is believed that the road will lead to the development of valuable iron ore deposits in a part of the country traversed.



The cannon about to be rolled up the skids to the automobile.

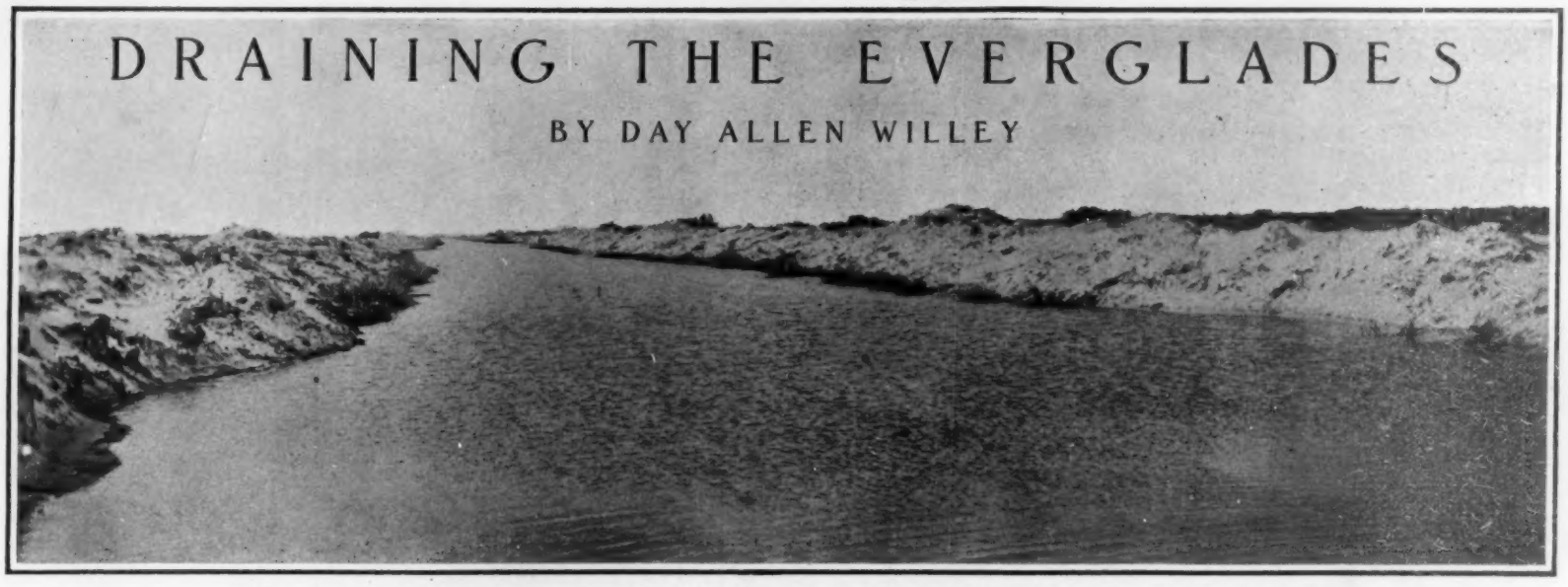


The cannon mounted on the automobile and locked in place by the skids.

AUTOMOBILES FOR TRANSPORTING AIRSHIP GUNS

DRAINING THE EVERGLADES

BY DAY ALLEN WILLEY



This canal was dredged out of the coral rock forming the cup-shaped barrier which keeps the water within the Everglades.

ALTHOUGH the efforts to reclaim the Everglades of Florida have been in progress only about four years, nearly 15,000 acres of what was formerly submerged land, partly covered with sea grass and other water growth, have been drained and over 12,000 acres of it utilized for the cultivation of fruit, vegetables and other staple farm products including sugar cane. The location and extent of the reclaimed territory prove the theory of drainage experts that the water upon a very large area of the Everglades can be removed from it by the present system employed. This area of South Florida is at such an altitude above the sea level that the current created through out-flow canals will be sufficient to carry away the water which prevents fully 4,000,000 acres of what is now waste land from being productive; although, as shown by soil analysis, the products of the first 2,000 acres reclaimed were of such value, owing to the fertility of the soil, that its quality for profitable agriculture was verified by the revenue from crop sales.

The Everglades occupy more than half that portion of the State of Florida south of Lake Okeechobee—the largest fresh water lake wholly within the United States except Lake Michigan, including fully 5,000 square miles by survey estimate. In this region there lies upon a stratum of coraline limestone an accumulation of sand, alluvial deposits and decayed vegetable matter. The latter is of such thickness that the productive soil averages from four to fully ten feet in depth. Upon the muck rests a sheet of water, the depth varying with the conformation of the bottom, which is very rough and irregular. It is largely the overflow of the lake and the entire problem of removing it rests in some method of lowering the lake and thus preventing its flooding the land surface. The depth of water over the Everglades has been measured at various points and in different seasons of rainfall. The result of the measurements show that the maximum depth at any time is about three feet, and this has given the experts an idea of the size of the drainage canals to keep Lake Okeechobee at a height where it cannot overflow. The mass of vegetation covering the Everglades is an indication of the fertility of the soil, the surface water being hidden in many places by grass that grows from eight to ten feet above it. It has a serrated edge and hence it obtains its name of "saw-grass." In many portions of the Everglades the saw-grass is so thick as to be impenetrable; but it is intersected by numerous and tortuous channels, that form a kind of labyrinth where outlets present themselves in every direction, terminating, however, at long or short distances in impenetrable barriers of grass.

In considering the problem of drainage, the question of the elevation of the Everglades has been of great importance and numerous investigations have been made and measurements taken. The opinion of geologists is that this portion of Florida has been forced upward at least twice in the world's history by subterranean movements, thus forming a plateau, the bottom gradually curving upward with a rim completely inclosing it consisting of colitic rock formed of coral and limestone. The results of measurements made by instruments show the crest of the rim to vary in height above sea level from 15 feet at high tide to 21 feet at low tide.

The dredge was recognized as the most practical machine for excavation; but special designs would be required for excavating the rock formation, also working in soft material. The first machines were designed by Captain R. E. Rose, who was appointed engineer by ex-Governor Broward of Florida, the principal promoter of the reclamation project. The scheme planned by Captain Rose, afterwards verified by Captain J. O. Wright, Supervising Drainage Engineer of the United States Government, was as follows: To construct one canal from New River to Lake Okeechobee, a distance of 55 miles; one to the west from Lake Okeechobee opening the Caloosahatchee River, a distance of 23 miles; one to the east from the southeast end of the lake, around the ridge to the St. Lucie River, a distance of 35 miles, making in the total a system of main canals of 113 miles, each at least 60 feet wide by ten feet deep. In his estimate Captain Rose provided for three miles of rock at the head of each canal to be excavated at a cost of ten cents per cubic yard, or $20,000 per mile, a total of rock excavation costing $180,000; 104 miles of muck cutting at 2½ cents or $5,000 per mile, $520,000; four modern dredges at $50,000 each, or $200,000; administration, surveys and superintendence, $100,000. Captain Rose figured that $1,000,000 was ample for this reclamation work. The work already completed by the State of Florida shows how close Captain Rose was in his estimates as to cost, for experience has shown the actual cost of removing the rock to be 8.51 cents per cubic yard and 3.46 for the muck.

The dredges used in rock excavation have been of the dipper type. The shovel buckets are provided with heavy steel teeth for breaking up the rock, and they work so rapidly that the largest has a capacity for removing nearly 3,000 cubic yards of material every ten hours. The first two completed began operation at the head of what is called the New River, about 20 miles from the city of Miami. The New River flows directly into the sea. Each dredge is excavating through the rim, a canal which averages 60 feet in width and has a depth ranging from 12 feet to 15 feet. So far nearly five miles of each canal have been completed; but the work is proceeding much more rapidly at present, as six excavators are now in service. As stated, the final objective point of all these canals is the south edge of Lake Okeechobee. When its surface has been lowered 5 or 6 feet it will draw in the water from the surface of the Everglades and this will create continual drainage from the swamp. If it should be deemed necessary its surface can be lowered 10 or 12 feet. The engineers will also cut a number of lateral canals, but these will be intended more for vessel transportation than for drainage. The soil is so very porous that a heavy rainfall disappears within a few minutes and it is thought that when the impounded water is drained off the land will take care of the natural precipitation.

The Board of Drainage Commissioners was created at Gov. Broward's suggestion by the legislature of 1905, with power to lay out drainage districts and to levy drainage tax of not more than ten cents per acre each year upon all the lands lying within such districts. In pursuance of this act a drainage district including the Everglades was laid out and a tax of five cents an acre was levied upon all the lands within it. This was opposed in the courts by several large land owners, also railway companies, but another act by the legislature laying out the district and levying the tax was sustained by decision of the United States Circuit Court of Appeals in 1907. This decision means that the Trustees of the Internal Improvement fund have the immediate co-operation of the Board of Drainage Commissioners, and all funds from the special tax are available for the expense of the work. This special acreage tax aggregates more than $200,000 per annum.

To provide a complete drainage system will necessitate the construction of about 600 miles of outlets. Most of this work, however, will be merely mud excavation. It is intended to pierce the rim at several other points with canals which will connect with tidal rivers like the New River, and the success attained warrants the undertaking. As the channels are dug the surface water in the vicinity finds its way into them and flows eastward. The soil of the Everglades is rich, not only in isolated places, but uniformly rich, as is shown by the many analyses made of it. These show that the percentage of nitrogen in the earth is over 2.21 per cent, which is a very large proportion of this powerful fertilizing element, but it has accumulated during the long period in which vegetation has been decomposing. At market prices for nitrogen it is calculated by the chemist that each ton of this soil contains fully $6 worth.

With land of this fertility, favored by the climate, the Everglades, where drained, are being occupied by farm settlers from many other parts of the country. Every kind of fruit and vegetable raised in the temperate zone can be cultivated at a profit, to which may be added oranges, bananas, pine apples and other varieties of tropical tree and bush products. The farms under cultivation since the reclamation work afforded land for the purpose, prove this to be true. This land is being sold in large tracts by the State authorities at $20 an acre to be divided into truck and other farms by large corporations that have been organized in various cities, but the possibilities for producing sugar are perhaps the most important in connection with this great reclamation scheme.

It is the opinion of Gov. Broward and many other experts who have carefully studied the situation, that the growing of sugar cane and the manufacture of sugar will eventually be the chief industry. Louisiana produces more cane sugar than all the other states combined, and is known for its production and quality. The average yield per acre in that state is twenty-five tons of cane, and the average available sugar content of that cane is seven per cent. The average cane production of the Everglades ascertained by striking an average on 420 acres for several years, is 35 tons of cane per acre and the average available sugar content ascertained in the same way is eight per cent. The addition to the soil of potash and phosphoric acid does not materially increase the gross tonnage of this yield, but it does very materially increase the available "content." In the Everglades region there are at least four million acres of land suitable for growing, as stated, crops of sugar cane. If the area submerged by the outlying waters of Lake Okeechobee, which is now being reclaimed, were planted in sugar cane and should yield 35 tons per acre with an average available sugar content of eight per cent the total annual production would be a little more than seven million tons, or enough to supply the demand of the United States for more than two years.

All told the American sugar production averages annually about 500,000 tons. To meet the consumption 2,250,000 tons are imported. Consequently the Everglades alone could produce about three times as much yearly as the country needs and about fourteen times our present annual output.

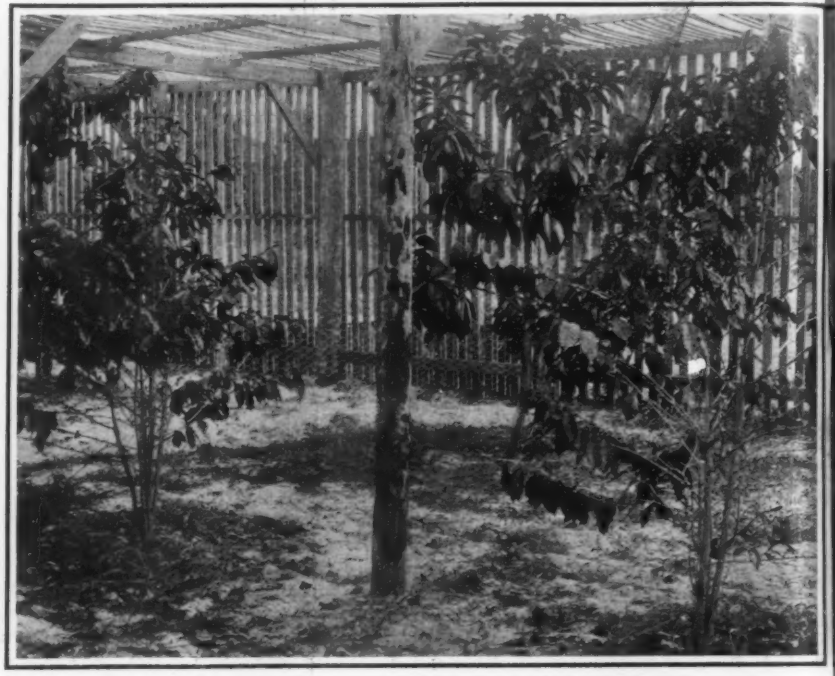
Statistical inquiries by the Department of Agriculture have been made in regard to the prices of beef and pork, to ascertain the difference between wholesale and retail costs. A study of the marketing and transporting of grain in the region of the Great Lakes dealt with the reduction in the cost of marketing and the increased quantities handled during the last quarter century. An examination of the cost of selling and delivering grain and live stock in the Pacific coast States was begun. Wages of farm labor were further studied, including cost of living as compared with that of city employees. A study of dates of planting and harvesting crops throughout the world has been under way.

Summer squash on the Braddock farm.

A farm with celery, onions and cucumbers.

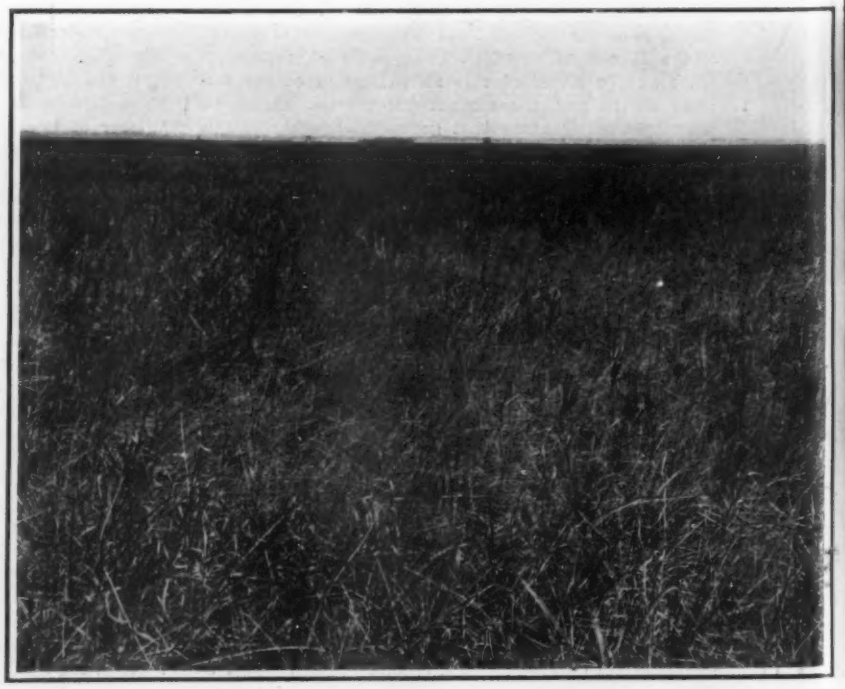
A drainage canal for carrying tailage w

Crude dam partly carried away by rush of water out of the Everglades.



Coffee plant at United States experiment station.

Northern drainage canal, showing natural current out of the Everglades.

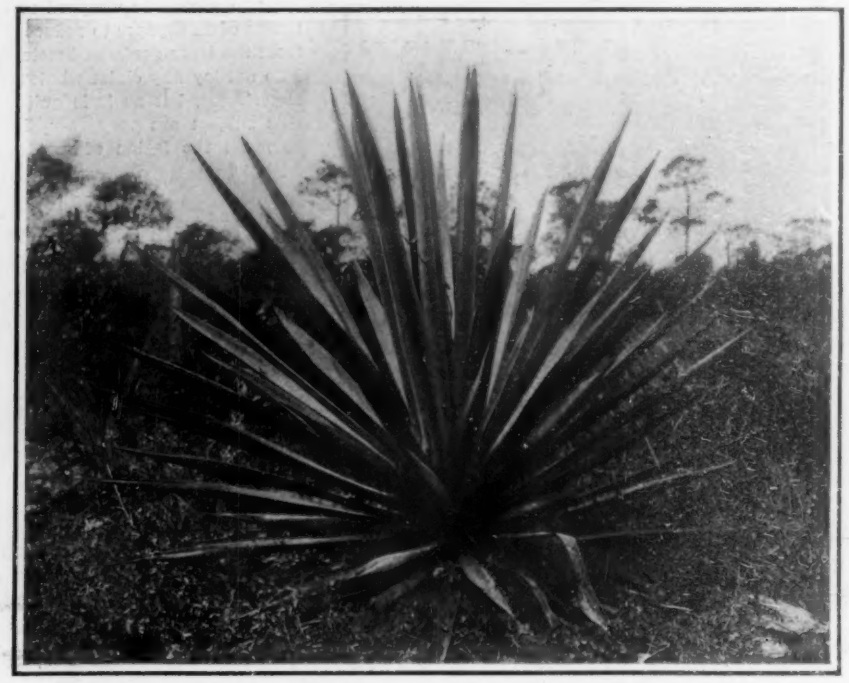


View of stretch of Everglades, showing the characteristic saw-grass.

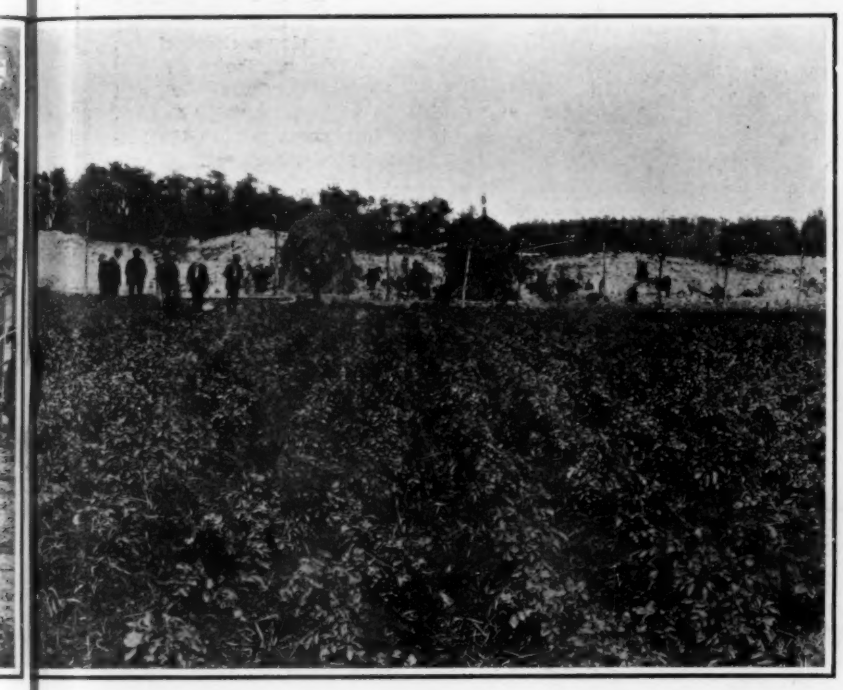
RECLAIMING THE EVERGLADES OF FLORIDA.—FOUR MILLION ACRES WILL BE REC

ng t nage water into the new river.

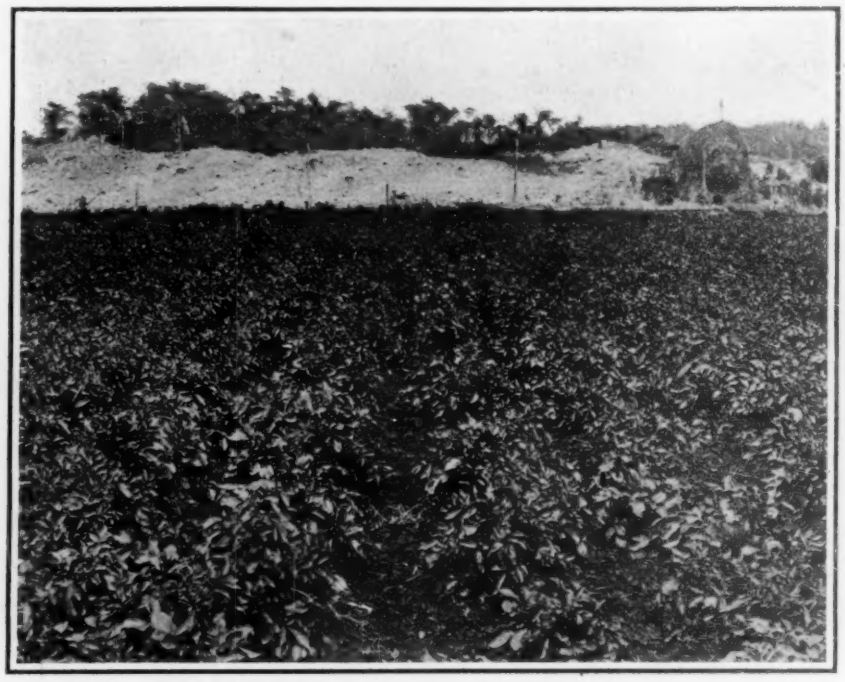
One of the huge steam shovels at work.



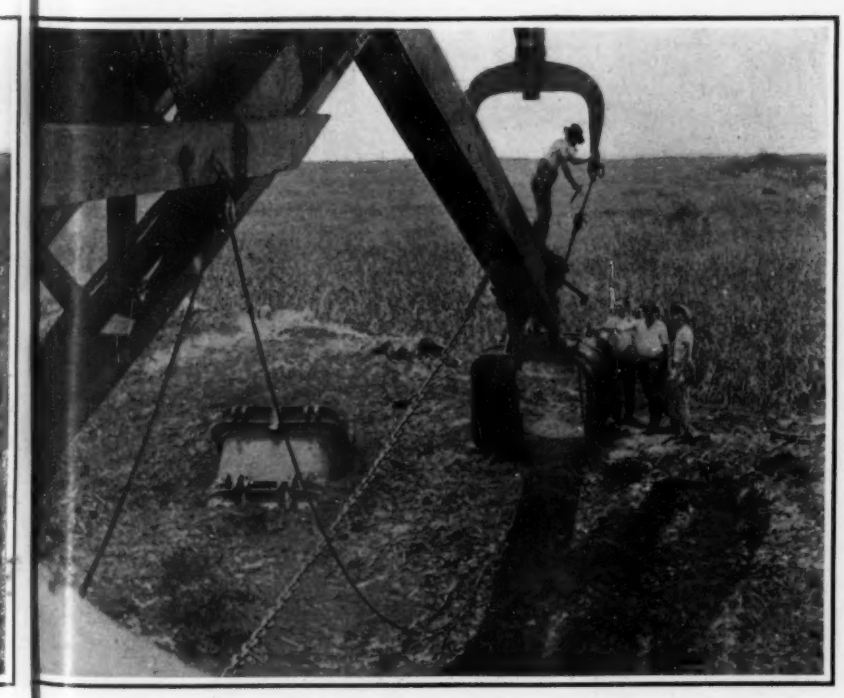
Sisal hemp at the United States experiment station.



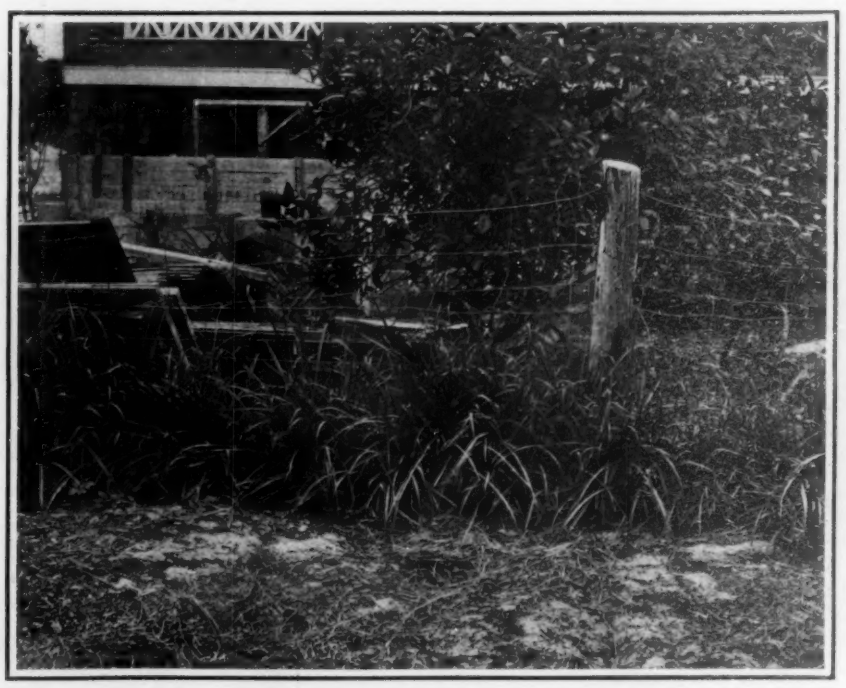
This crop was raised without any fertilization.



Worley farm, showing growth of potatoes without fertilizer.



Type of dredge used in digging the drainage channels.



Rhodes grass on United States experiment station.

RECOVERED BY DIGGING 600 MILES OF CANALS AND OUTLETS.

[The Editor of the Home Laboratory will be glad to receive any suggestions for this department and will pay for them, promptly, if available.]

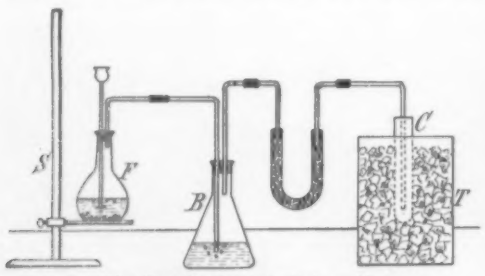
The Liquefaction of Nitric Oxide

By Robert H. Bowen

Probably every amateur delver into the stores of science has heard of liquefied air and the phenomena of liquefied gases. Few, however, are aware of the fact that liquefying may be done at home on a small scale, very cheaply, provided that the proper gases for such treatment be selected. In the following experiment no abnormal pressure is required as in the case of most gases, and simple cold suffices to condense the gas, which will be nitric oxide.

The apparatus for preparing and "freezing" the gas is shown conventionally in the accompanying figure. *F* is a small flask of about 250 cubic centimeters capacity, supported for safety and convenience on the ring stand *s*. The flask is provided with a two-hole rubber stopper, through which passes a thistle tube and a small angle piece of glass tubing. The angle piece is connected by a piece of rubber tubing to a glass tube, the opposite end of which is immersed in the water contained in the bottle *B*. Another short tube leads to a U tube filled with granulated calcium chloride. The U tube connects with the test tube *C* by means of a glass tube and a short section of rubber tubing. The test tube is contained in the can *T*.

To perform the experiment, place in *F* about 1 ounce of copper turnings or short lengths of copper magnet wire, and fix the stopper tightly in place. Fill the bottle *B* with water, the level of which should be somewhat above the end of the long tube. Stopper *B* tightly, and connect by means of the short angle piece to the drying tube. Pack the test tube in a mixture of



The liquefaction of nitric oxide.

ice and ammonium chloride (sal ammoniac) after the manner of filling an ice cream freezer, care being taken that no water is allowed to enter the test tube. All is now ready to commence. Pour slowly into the thistle tube enough nitric acid to seal its end. Action at once occurs with the copper, and brownish fumes fill the flask. The gas as originally generated is really colorless, and is called nitric oxide (NO). On coming into contact with the air, the gas at once oxidizes, taking on a brownish hue, and becomes nitrogen peroxide (NO_2). When sufficient pressure is obtained, the gas bubbles up through the water in bottle *B*, and passes thence through the calcium chloride tube, at length arriving in the test tube, which is contained in the freezing mixture. Here the gas is condensed into a fluid, the color of which, if perfectly pure, would be like that of water. However, it will probably have a slight bluish tint. Unlike water, the fluid will not solidify, which water would speedily do if subjected to the same conditions.

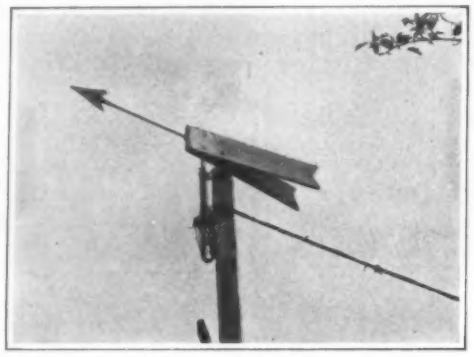
The quantity of liquid thus obtained is very small, and experimentation with it is rather restricted. One experiment may be tried with only a single drop of the fluid gas. Remove the test tube from the freezing mixture, and warm the bulb with the hand. The fluid vaporizes slowly, and the customary brown fumes appear. Now seal the open end of the tube with the thumb, and replace in the freezing compartment. The gas is speedily recondensed, and forms a partial vacuum in the tube by the decrease of its volume. This is made evident by the sucking effect which is exercised on the flesh of the thumb. The brownish fumes disappear simultaneously.

Should the action in the generating flask slacken, it may be accelerated by the addition of more nitric acid. The wash bottle and calcium chloride tube may be dispensed with if they are not contained in the amateur's laboratory, but it is advisable to use them. A large tin can serves very well for a container for the ice, and should be wrapped outside with several thicknesses of newspaper to reduce the radiation consequent from the large surface of metal which the can presents. I do not lay any claim whatever for originality to this experiment, but as it is quite unique and articles on this subject are very rare, I thought it worth while to make the legion of amateur scientists acquainted with it.

A Unique Wind Vane and Electric Indicator

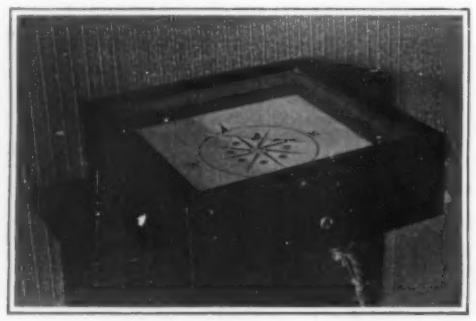
By Frank C. Perkins

The wind vane pictured herewith is connected electrically to an instrument at a considerable distance,



Weather vane electrically connected to indoor indicator.

which indicates, by means of a magnetic needle, the direction of the wind. This apparatus is of value to an observer situated where he cannot see the vane from a window, and especially at night, when the direction of the wind is difficult to determine. The vane is made as light as possible, and in such proportions that it will balance nicely on the bearings, which consist of the head of a worn-out bicycle. The vane is held in place by means of a ½-inch iron pipe, which extends down into the head. The clamp formerly used



Indicator for the weather vane.

to secure the handle bar will hold the vane in place. In place of the forks is attached an eight-cylinder automobile timer, slightly altered in such a manner that the brush is always in contact, and when pointing between two contacts, connects them both.

The indicator consists of eight 4-ohm magnets arranged 45 degrees apart in a circle on an inch board, with their faces pointing toward the center. These can be obtained from any electrical store in pairs, and are termed instrument magnets. They are held in place by small angle brackets, as can be seen in one

The indicator dissected.

of the engravings. Covering these is a thin board, to which is fastened a neatly drawn dial resembling a mariner's compass card. The cover is easily made from a picture frame, with four small boards arranged to take the place of the picture as shown. The indicator needle is a simple magnetic needle balanced on a pivot over the dial. Around the indicating end of the needle, which is painted black, is wound a fine wire, the end of which extends down to about 1/32 inch of the dial.

There are eight wires, which connect the outside wires of each of the magnets to a contact of the timer. The inside wires of the magnets are connected to the iron brace which supports the magnets. The braces are connected to each other by a ground wire, and in series with a push button and two or three dry cells of battery with the timer brush. The timer should be fastened in such a position that when the vane is pointing north, the brush will make a connection directly in the center of a contact. The contacts and magnets are connected in such manner that when the vane is pointing in a certain direction it will connect the batteries with the magnet under the dial, representing the direction from which the wind is blowing.

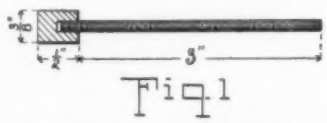
It will be seen that when the vane is pointing in such a direction that two of the contacts are connected, two magnets will be magnetized and the indicating needle will point midway between two lines on the dial, thus giving 16 directions. The magnets under the dial, when magnetized, will attract the needle and, on account of the "dip" caused, will bring the end of the fine wire in contact with the dial, thus preventing the needle from swinging a few moments before coming to a standstill.

It may be mentioned that by using a closed circuit battery and not using a push button, the needle will at all times indicate the direction of the wind, and can be read at a distance without requiring the observer to go close to the instrument to push the button, as is the case when dry cells are used.

A Self-cooled Spark Gap

By George F. White

Wireless experimenters possessing stations of ¼-kilowatt capacity or more, often experience difficulty in making their spark work properly after the electrodes have once heated up. This trouble is partially eliminated if transformers are used that are wound for a high voltage. The higher the voltage



Dimensions of the adjustable electrode.

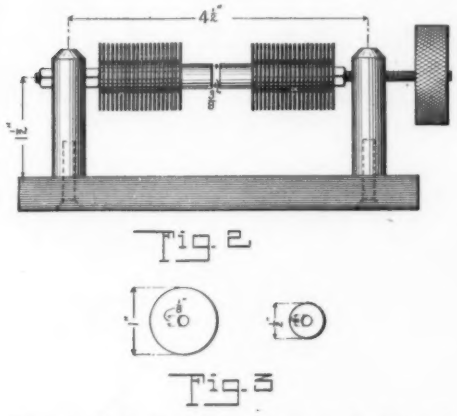
the greater the pressure, and the more easily the secondary discharge will leap a given distance. A 250-watt transformer, if wound for a secondary discharge of 8,000 or 10,000 volts, will leap a gap hardly more than 0.25 or 0.35 of an inch, while one of the same wattage, but with the secondary wound to 15,000 volts, will easily leap a space of 0.35 or 0.45 of an inch and even more. Of course, the amperage is greater in the former than in the latter, owing to the necessary increase of resistance of the latter because of the extra turns necessary to bring the voltage up.

It can be seen by the comparison of spark lengths that a transformer of low secondary voltage will necessarily use a shorter spark for transmitting than the one of higher voltage. When the electrodes of the oscillator or gap become heated, the spark becomes weaker and needs shortening. In the transformer of higher voltage this is not always necessary, as the greater pressure can usually maintain a regular spark. However, the lower voltage transformers are being used almost universally, on account of the higher amperage and subsequent radiating and penetrating qualities of the discharge. A spark maintained between cool electrodes has a higher frequency per second than one between heated ones, and hence a greater radiative power. Hence it is evident that some method must be used to keep the electrodes of the discharger as cool as possible, to augment the use of the lower voltage. There are several methods in use now that are very ingenious. One consists in blowing a current of cool air forcibly upon the electrodes; another, in the use of radiators. To obtain the best results with the former method, the gap should be inclosed in a small air-tight case, at the bottom of which a rubber tube should enter. This should lead to an electric fan. The current of air produced by the fan is collected by means of a large cardboard funnel, the small end of which terminates in the rubber tube. At the top of the gap another such tube should lead to the outer air. This carries away the particles liberated in the discharge,

also the heated air. The other type of cooled gap, and the one from which this article derives its title, is of the self-cooled type. It is more desirable from the amateur's standpoint than the other method, being cheaper and comparatively easy to construct.

For the electrodes, zinc pencils having a ⅜-inch face can be used. They should each be ½-inch in length and tapped for a 10-24 screw 3 inches long.

A ⅜-inch surface will be ample for discharges up to 1 kilowatt. Larger sizes are necessary for greater capacities. The radiators are made in the form of



The assembled self-cooled spark gap and a disk and washer.

washers 1 inch in diameter of No. 20 sheet zinc (Fig. 3). The hole at the center should be a trifle larger than ⅛-inch, to allow the radiators to slip over the 8-32 threads. It can be made with a center punch, and the rough points on one side of the disk (caused by punching) filed away. There will be twenty such disks needed for each electrode. They should be alternated by small copper washers for spacing (Fig. 1). When the disks are in place they should be clamped securely with a 10-24 nut.

Binding posts made of hexagonal or round brass are necessary to support the gap electrodes (Fig. 2). They can be mounted on either rubber, fiber, or marble. The electrodes are threaded into the posts, one being made fast with a nut while the other has a knurled rubber handle for adjusting purposes.

The two posts are made fast by means of screws that pass up into them from countersunk holes in the base.

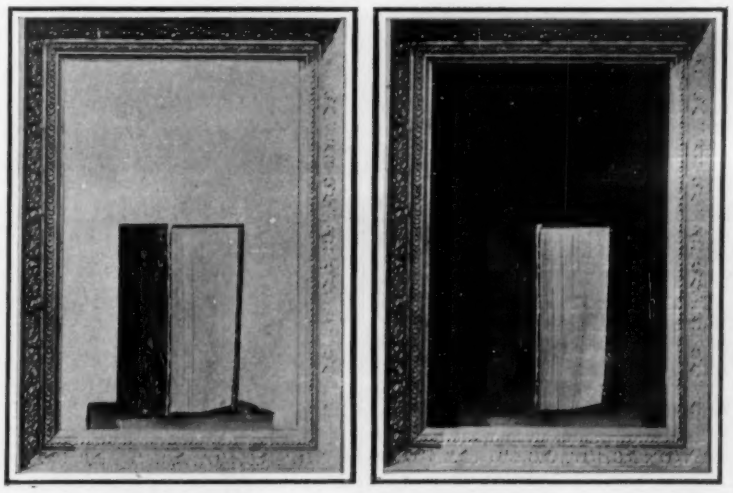
A Mirror Illusion

By Prof. Gustave Michaud, Costa Rica State College

A curious mirror illusion may be obtained with the accompanying figure. The best way (not the only way, however, as we shall see further) to get this illusion is to place the figure on the edge of a table, near a window, and to look at it with a stereoscope brought at the required distance, the projecting rod of the instrument being thus kept outside of the table. Besides the ordinary stereoscopic relief, another phenomenon appears which gives the stereogram a most extraordinary aspect. The mirror assumes a thoroughly metallic surface, just as if a sheet of highly polished silver had been glued over the paper. As to the books, they are not seen upon the metallic surface, but behind it, exactly as if their image were reflected by the mirror.

Where no stereoscope is at hand, most people will get the same illusion by making in a sheet of black pasteboard two holes about ¼ of an inch in diameter and exactly 2½ inches apart, distance being measured from center to center. The figure is laid upon a table in a well-lighted place. The observer stands up and holds the sheet of pasteboard at some 3 to 6 inches from his eyes, so as to enable each eye to see the corresponding photograph. If the figure be then considered in an absent-minded way, as if it were some far-away object which the observer does not care to examine, the optical axis of the eyes, in most cases, becomes parallel; the two holes get nearer, and finally merge into one single hole, through which the illusion is obtained with as much intensity as with the stereoscope.

The fact that one eye sees a highly luminous surface where the other sees practically no light at all, causes the illusion. Although they may be very finely grained and apparently polished, opaque surfaces which are not metallic diffuse light in every direction, and send about as much of it to one eye as to the other. Highly polished metallic surfaces, on the contrary, reflect only in one direction the light which comes to them, if a small part of the reflecting surface be considered. When our eyes are close to such surfaces, it often occurs that one eye is in the direction of the reflected light, while the other is not. One eye sees light where the other sees none. We have then what may be called the metallic visual sensation. This sensation is, of course, entirely subjective, and, just as the sensation of light may be produced without light, the metallic visual sensation may be produced without metal, through the artifice just described.



Place this in a stereoscope and note the mirror illusion.

A Freak Barometer

By Albert Alexander Somerville, Ph.D.

It is a well-known fact that a plant receives water at its roots and loses the same at its leaves by what is called transpiration. The subject is of much interest to plant physiologists in accounting for the means of transit of such a great quantity of water as is known must be conveyed through the trunk of a tree.

If the leaves of a plant are partly wilted after a hot day, it is probably because more water has passed from them by evaporation than they have received; by morning however they are again rigid, which is evidence that during the night enough water has been conveyed to them to account for this excessive loss of the previous day.

Experiments show that the amount of water drawn by a plant is much greater than one would ordinarily expect; also when one considers the height to which it must be raised in some of the tallest trees, it is seen that the work done in a forest is easily more than equal to that of a city water works department.

The ordinary way of beginning the problem is to consider that the water is pushed up from the bottom; this is done by what is termed root pressure or bleeding pressure.

Another method of producing unequal pressures is by osmosis, or semi-permeable membranes consisting of porous materials which will allow a certain solution to pass one way only, and thereby increase percentage of solution on one side and decrease it on the other side.

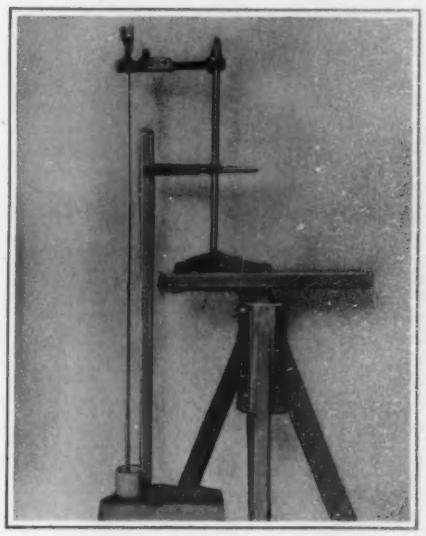
Neither of these however will lift water to any great height, and even if we add to them the height water may be raised due to atmospheric pressure, it is still far short of the total height of most trees.

Then if we have used all the means known to produce a "push" at the bottom, it is only natural to consider what we can find at the top in the way of a "pull."

The first of the phenomena we consider is that of capillarity. The laws of physics are that the height to which a liquid will rise in a capillary tube is directly proportional to the surface tension of the liquid in contact with the tube, the angle it makes with the tube, and inversely as the size of the capillary. Well, this latter being the case theoretically, it is only necessary to make the capillary small enough, and water can be raised to any height desired. This may be all true enough, but there is another law yet to be considered, and that is, that the amount of liquid that will flow through a capillary is inversely as about the fourth power of the diameter of the tube. Now if the tube is small enough to lift water to any considerable height, it is so small that scarcely any water will flow through it, and so the amount lifted to the top will be very small indeed.

Since the amount that does reach the top is very great, another force is probably in use. The water may first reach the top through small capillaries and spread through the woody fibers, becoming attached to these by the force of adhesion, and then support a column due partly to the cohesion of water particles.

An experiment tending to prove this is described by Askenasy, and has been performed by the writer in his research laboratory simply for the pleasure of seeing the same in operation. The accompanying photograph is of the same, which is described herewith.



A freak barometer.

If a glass tube open at both ends has one end well closed with a block of gypsum or plaster of Paris, this block so long as saturated with water vapor is almost wholly impervious to the passage of air. The tube is filled with water, inverted, and placed open end down in a vessel of mercury as an ordinary mercury barometer. The air should be boiled from the water. The water then evaporates from the top of the plaster of Paris plug, and the water from below follows through, drawing the mercury column up after it, due to atmospheric pressure.

After the ordinary barometric height is reached, the mercury column continues to ascend, probably due to the adhesion of water and mercury, cohesion of mercury, cohesion of water, and adhesion of water and plaster of Paris.

The apparatus was constructed by drawing down a large tube at one end and sealing it on to a smaller tube about 125 centimeters long. Diameter of tube, 4 millimeters; diameter of large tube at top, 20 millimeters; length of plaster of Paris plug, 3 centimeters. The experiment was started October 26th, 1910, at 8 A. M., and the following table shows the rate at which the water passed through the porous plug:

	Time.	Height of Mercury Inches.
Oct.	26— 8 A. M.	0.
	27— 8 A. M.—1 day	6.5
	28— 8 A. M.—2 days	9.
	29— 8 A. M.—3 days	13.
	30— 8 A. M.—4 days	17.3
	31— 8 A. M.—5 days	25.
Nov.	1— 8 A. M.—6 days	33.
	1—11 A. M.	35.

The picture was taken at this time, and the scale shown is a meter stick ruled in inches on one side, and not a yard stick as might be supposed.

During the second, third, and fourth days the humidity was very high, so that evaporation was slow. During the fifth and sixth days a test tube containing calcium chloride was inverted over the top to absorb moisture and so hasten evaporation. The difficulty is that some air will pass through the top, and thereby cause the column of water to break loose at the top, but nevertheless it holds long enough to prove the point, and earns the title of the freak barometer.

A patent was recently granted to a Schenectady man for a golf club provided with a tubular non-fibrous shaft; or, more specifically defined, a shaft of steel tubing.

The Man-machine

(*Continued from page 60.*)

ability to contract muscles, since ordinary muscular contractions at very low temperatures are impossible.

Laboratory experimentation has shown the essential nature of this chemical process, and its relation to fatigue. The great storehouse of glycogen (muscle sugar) is the liver, which organ takes it from the alimentary tract and supplies it through the blood to the muscles, as their smaller stores are used up. A muscle being stimulated to contract, there is a reaction between the oxygen of the blood and the glycogen; and the result is the formation of waste products and a release of energy, part of which latter contracts the muscle, while the rest in the form of heat is either wasted or used to maintain the bodily temperature.

Fatigue is usually attributable to the waste products formed in the reaction just stated. If the extract of a fatigued muscle be injected into animals, great languor and prostration result, with indications of fatigue. To inject extract of non-fatigued muscle has no effect at all. A fatigued muscle is one in which by reason of repeated contraction, there has been much chemical change—with the accumulation of waste products. Thus soldiers, after an exhausting march, are as arm tired as they are leg tired.

The fact that the workman who does not rest gradually loses his energy should certainly be a most vital matter for employers of labor to consider, if not from the humanitarian, at least from the economic and purely Gradgrind viewpoint.

We have now an American Museum of Safety, established in the Engineering Societies' Building in New York city; here one finds many inventions and contrivances for the preservation of human life. It is the fourteenth of its kind in the world; but the first in the United States. There are a dozen such museums in Europe, where the subject has long interested social scientists and those who make human welfare their earnest concern. In Germany, for example, accident prevention has been reduced to a system; and the number of industrial accidents has been reduced 50 per cent.

But the best surety against accident is an alert mind in a virile body; and on the other hand, the ideal predisposition to accident is an exhausted, rundown, devitalized human machine. There is now no question of the reality of the relation between fatigue and accidents; in Europe this has been scientifically noted for practically all forms of human activity. Bank clerks make most of their mistakes in the late afternoon; and this appears to be one of the reasons for the comparatively early closing of such institutions, since the bankers have found their employees' mistakes to be expensive. Everyone now knows that dire calamity results when railway men work continuously too many hours. People should understand also that physicians are not to be overworked; and that rather than this, substitutes or assistants had best be willingly accepted; men who have in their charge the keeping of human health (the most precious thing in existence) must be vouchsafed normal minds in normal bodies. The part-time method of school attendance of children is, I doubt not, oftentimes unavoidable. Still it has disadvantages; and of these by no means the least is that in the afternoons the minds of children are unfairly taxed; as when they are made to grapple with such difficult subjects as mathematics, which should be a morning study, when the minds of children are clear and fresh.

One here perceives the best of all arguments—from whatever viewpoint one chooses—for the eight-hour day for all forms of labor. For some kinds of labor even eight hours is much too long. It is melancholy to observe that for many employers the prevention of fatigue accidents can be brought about only by making them very expensive. A wise corporation, however selfish, will here instinctively reduce its hours of labor; for reasons of economy, if for no other. After all it is gratifying to note that the essential parallelism of efficiency and humanity is being increasingly appreciated throughout civilization.

Our Smokeless Cannon Powder the Best

(*Continued from page 63.*)

specifically mentioned the use of grease and oil, to render the material less sensitive and less likely to be detonated accidentally.

The following, quoted from Sir Hiram Maxim's letter to me, dated August 8th, 1889, proves what his opinion was at the time of writing it: "There is nothing new about the addition of nitroglycerin to a solution of guncotton. It was patented fifteen years ago by Nobel." Even the use of castor oil by Sir Hiram Maxim was based on an erroneous assumption. It was thought by him that any colloid of guncotton or colloidal compound of nitroglycerin and guncotton, both ingredients being high explosives, must necessarily be a detonative compound, requiring some sort of deterrent to adapt it to use in guns. Experience has proven that no such deterrent is required; for the dense, horny, tenacious character of the material itself absolutely obviates any danger of detonation, whether the colloid be made of pure nitrocellulose or of any compound of nitrocellulose and nitroglycerin up to 60 per cent of nitroglycerin to 40 per cent of nitrocellulose.

As Sir Hiram Maxim never used over 25 per cent of nitroglycerin in any of the laboratory samples made by him, and seldom employed more than 5 per cent, it is easy to see how little importance should be attached to his castor oil patent. Even the use of castor oil by Sir Hiram Maxim in smokeless powder was suggested to him by me. I learned from Prof. Fowbray, who was at the time connected with the Xylonite Company of North Adams, Mass., that they had experimented with the use of castor oil in their xylonite or celluloid; but it did not work well, and was consequently discarded.

In view of all the foregoing facts, it does seem a little impertinent that a man of Sir Hiram Maxim's very limited experience in explosive compounds, ignorance of their nature and use, should write letters to our Chiefs of Ordnance and to our President, that our smokeless powder is all wrong and that our government officers who are responsible for the adoption of its form, and who have developed the material of which it is made, do not understand their business and should, metaphorically speaking, be hauled over the coals and set right.

Had it not been for the world-wide reputation attained by Sir Hiram Maxim, due to his invention of the automatic gun, and the honor conferred on him by the English crown by knighting him, his letters to our Bureau of Ordnance and his letter to the President would have received no attention whatsoever, and the matter would never have become public.

In 1895 I had a contract with Hiram Maxim, by which he was to receive a certain commission on any sale of the Maxim-Schüpphaus smokeless powder patent rights, which might be effected with his co-operation and assistance; and it is interesting to know what his opinion was of the powder and of my multiperforated grains when that contract was in force. I quote the following from a letter written by him to Lieut. J. F. Meigs, Engineer of Ordnance, Bethlehem Iron Works, Bethlehem, Pa., dated 32 Victoria Street, London, S. W., August 8th, 1895:

"This new form of powder has multiple perforations. If powder is only perforated with a single hole, it burns from the outside and the inside at the same

(*Continued on page 76.*)

RECENTLY PATENTED INVENTIONS.

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Pertaining to Apparel.

HAT FASTENER.—J. TAUSS, Bayonne, N. J. The fastener is more especially designed for use on ladies' hats to fasten the same securely in position on the head. For this purpose use is made of one or more combs forming a permanent fixture on the hat, to readily engage the wearer's hair on placing the hat in position on the head.

BELT BUCKLE.—J. F. DUNN, New York, N. Y. This invention provides a buckle wherein the grip on the belt is proportioned to the pulling strain; provides a construction for the gripping member to make the same more rigid and to afford guides for the operation thereof; and provides a buckle which is simple, effective and durable.

Electrical Devices.

DEVICE FOR DRIVING FISHES.—C. K. FREER, Sandusky, Ohio. To some extent this invention is in the nature of a subaqueous alarm. More particularly stated, it comprehends a number of buoys to be connected with a seine or the like, and containing alarms which are controllable electrically from a predetermined point, in order to frighten the fishes and drive them into a predetermined position or along a definite path.

ELECTRICAL ILLUMINATING SIGN.—W. W. ARNOLD, Hamilton, Ohio. This invention provides an apparatus for producing illuminated display figures successively to form words or other symbols; provides means whereby the foregoing object is accomplished through a selecting apparatus mechanically operated; and provides a construction whereby the successive words, sentences or combination may be maintained in illuminated form or obliterated at the operator's will.

Of Interest to Farmers.

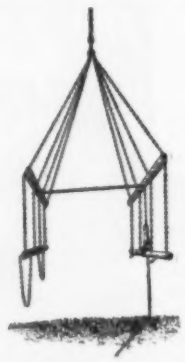
COTTON-CLEANER.—A. L. TREESE, Jennings, Okla. The present invention constitutes an improvement on that described in a former patent granted to Mr. Treese, the object being to enable the cleaner to be used, if desired, without the separator, and arrangement being provided in which the cotton is deposited directly upon a conveyer belt or distributor.

CHURN-DASHER.—W. W. LILES, Mineral Wells, Texas. The object of this invention is to provide a dasher which will churn the butter in a simple, cheap and efficient manner. By making the dash-head convex on top and concave underneath, the downward movement of the dasher will force the cream to the center and the upward movement of the dasher will then force the cream outwardly, this alternate forcing of the cream toward the center and then outwardly, facilitating the operation of churning.

FRUIT PICKER.—A. H. BASTIAN, Portland, Oregon. The aim of the invention is to provide a new and improved fruit picker, arranged to insure ready detachment of the fruit from the tree and to prevent bruising thereof during the act of detaching the fruit and lowering of the same to the ground for the removal from the picker.

CHURN.—W. W. LILES, Mineral Wells, Texas. This invention has reference to improvements in churns and means for driving the same, and has for its object the production of a simple, cheap and efficient mechanism, whereby the churning operation may be performed in an expeditious manner. It consists of few parts, the framework being cast in one piece, and the parts are so arranged that they can be readily assembled and disassociated.

STRAW HOISTING NET.—GEORGE GLASER, Halleck, Nevada. The accompanying engraving illustrates a hoisting net for straw and the like. It comprises two sets of chains secured to the cross bars, which serve as spreaders. One of the cross bars is fitted with pins, on



STRAW HOISTING NET.

which the chains from the opposite cross bar are hooked. The first cross bar is then rotated to coil up the chains, and hold the net in carrying position. The bar is kept from turning to release the chains by means of a latch, which, however, may be sprung by drawing a cable depending therefrom.

SEED-TESTER.—H. L. LAPHAM, Caledonia, Minn. By means of this device a large number of seed samples can be tested at the same time. It also provides means for identifying the various samples of seeds in which the possibility of confusing the seeds is almost entirely eliminated, while it permits the seeds to be easily inspected at all times, and it can be manipulated without difficulty, both in placing the seeds in the device, and removing them for inspection.

COTTON PRESS.—A. L. TREESE, Jennings, Okla. The invention provides a press to roll loose cotton into a sheet and the sheet into a roll or bale shaped under a uniform pressure; provides means for delivering from the press the bale when rolled; provides means for ascertaining when the desired pressure is exerted upon the bale; and provides means whereby any pressure is removed from the bale automatically.

COMBINED COTTON CHOPPER, SCRAPER, AND CULTIVATOR.—G. C. LACKIE, O. K., Miss. Among the principal objects which the present invention has in view are to provide a machine wherein the cotton may be chopped and the ground cultivated and leveled in the same operation; and to provide means whereby the operation above described may be carried on independently.

Of General Interest.

HOOF PROTECTOR.—A. J. GASTLIN, New York, N. Y. The device comprises relatively movable guard members adapted to be positioned under the hoof, within the shoe thereon, means for spreading the members outward against the sides of the shoe, and a common guard member movably associated with the first guard members and adapted to cover a gap between the same when they are spread in position.

SMOKING IMPLEMENT.—J. M. EDER, New York, N. Y. The invention relates to smoking implements, such as pipes, and cigar or cigarette holders, and has reference more particularly to a device of this class, composing a tobacco-holding member, a stem having a mouthpiece and provided with a passage of substantially uniform diameter, extending from the tobacco-holding member to the mouthpiece, and an absorbent cartridge in the passage.

METHOD OF OBTAINING SOLUTIONS OF QUASI SOLUTIONS OF CERTAIN METALLIC OXIDS.—Z. CARTWRIGHT, 33 Clarendon Gardens, Ilford, Essex, England. The invention relates to a novel process of treating metallic oxides, notably those of metals contained in the iron series, viz., iron, manganese, chromium, which are insoluble in water and other media chemically indifferent to the said oxides, for the purpose of obtaining what is virtually a soluble form of certain of these oxides in a chemically inert medium.

PARASOL BAG.—H. K. HANSEN, New York, N. Y. The bag is designed for safely housing a large number of parasols and similar articles, such as umbrellas or canes, in a comparatively small space. Use is made of a main bag having sides tapering from the bottom to the mouth, and outside pockets arranged exteriorly of the main bag, closed at their lower ends and open at the top, the latter being a distance below the mouth of the main bag.

PROJECTILE.—J. F. O'BYRNE, Contact, Nev., and T. A. FLOOD, Salt Lake City, Utah. This invention is in the nature of a projectile in the form of a bullet or missile as the case may be, especially designed for use in catching wild animals, and has for an object to provide a projectile carrying a narcotic whose anesthetic effect will so affect the animal as to render the capture and control of the same easy.

BRICK CAR.—C. M. STEELE, Statesville, N. C. The improvement is in lift cars for use in handling brick and an object among others, is to provide a novel construction which can be easily operated to set the bed of the car up or down in order to lift or lower the load and which will be found convenient in handling brick and other material on pallets. Another object is to provide a lift car having only one deck, making it flexible, thus allowing the wheels to follow an uneven track.

APPARATUS FOR FACILITATING WALKING.—W. W. ANDERSON, Holly Springs, Miss. This improvement is in leg attachment adapted for facilitating walking or jumping. It is embodied in appliances or devices adapted to be secured to the thigh and foot of the wearer, and an intermediate connecting portion formed of springs, which are alternately fixed and extended in the act of walking.

LUMBER-PILER.—H. E. HARPER, Atwood, Kan. In the present patent the invention has for its purpose the provision of a platform which may be suspended from the end of a stack of lumber, by the lumber, and which is provided with a vertically adjustable roller over which the lumber moves to the stack.

SHUTTER OR FIRE-SHIELD WORKER.—D. ANTHONY, Greenwich, Conn. More particularly this invention relates to certain features of construction, whereby the worker may be used in connection with shutters or fire screens on windows set deeply into the wall of the

building. The worker operates to swing the shutter outwardly from the window casing, so that it can lie against the reveal of the wall near the window casing.

ADJUSTABLE HAND TYPE-MOLD.—A. S. TAYLOR, Nanuet, N. Y. The intention here is to provide an adjustable hand type mold, more especially designed for the use of printers to enable them to cast any type letter, sign or other character, or reproduce in type from any small electro or wood engraving for immediate use in letter press or other printing.

SWINGING CHAIR.—J. T. WILLIAMS, Reno, Nev. The back of this chair is adjustable to different inclinations, the back being controlled in its adjustment by the weight of the occupant on the seat of the chair, suitable locking means being provided to retain the back in substantially any of its positions of adjustment; thus, when the full weight of the occupant is on the seat of the chair, upon releasing the locking means the back is swung forwardly. By relieving the seat wholly or partially of weight the back is swung rearwardly.

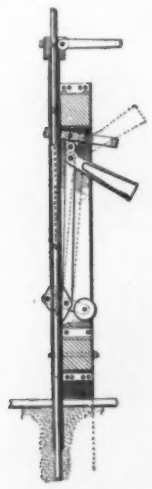
METHOD OF PRODUCING STABLE SOLUBLE CELLULOSE DERIVATIVES FROM VISCOSE.—L. LILIENFELD, VIII Zeitgasse 1, Vienna, Austria. The utility of this new product lies not only in its superior stability (it will remain stable for several months at the ordinary temperature of a room or longer if the temperature is lower), but also in its wider range of adaptability on account of its dry state, its neutral property, and its solubility in water, whereas the ordinary viscose, including xanthogenate or alkali cellulose-xanthogenate, possess but little stability.

MERCANTILE RECORDING APPARATUS.—A. N. QUIDOR, New York, N. Y. The apparatus is more especially designed for use in mercantile houses and arranged for conveniently making and keeping records of the movements of traveling salesmen, or keeping records of any matter involving the use of maps. Use is made of a map contained in a holder, provided with means for movably holding a sheet of tissue paper or tracing paper in position over the map, to allow of tracing a route on the sheet from the map below.

ELECTRIC FURNACE FOR THE CONTINUOUS EXTRACTION OF ZINC FROM ITS ORES.—E. F. COTE and P. R. PIERRON, No. 1 Rue d'Algérie, Lyon, France. In the present invention the improvement has reference to an electric furnace in which the zinc ore is treated by the so-called precipitating process according to which the zinc is displaced by the iron, thereby allowing to realize the essential conditions of the inventor.

DEVICE FOR CHARGING CAPSULES.—D. BRESCIA, Quito, Ecuador. An object here is to provide a simple, inexpensive and durable device for charging capsules with carbonic acid gas or gas of similar character, which is simple in operation, which can be easily controlled, and which requires no skilled labor for its manipulation. A large number of capsules can be charged at one time.

LIFTING DEVICE.—J. H. SPENCER and J. SIMPSON, care Macdonald Engineering Co., Memphis, Tenn. The purpose of this invention is to provide means for lifting forms in reinforced concrete construction, which will indicate the extent of the lift. The device consists of a frame, to which the form is attached, and this frame is provided with gripping means en-

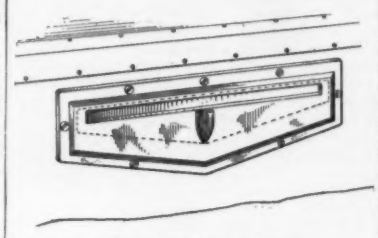


DEVICE FOR LIFTING CONCRETE FORMS.

gaging a graduated tube or sleeve, fitted over a graduated reinforcing rod of the concrete construction. By swinging the lever as indicated by dotted lines in the drawing, the frame is lifted on the sleeve. By using a number of these lifting devices, and operating them simultaneously, a form of any desired length may be raised.

SPLIT SLIDING SWIVELED DENTAL MOLDING-RING.—P. BOURNE, New York, N. Y. This invention provides a ring wherein a mold is formed for casting a die for making dental metal crowns, the ring being arranged to part the mold in a radial path to form accurate half molded sections; provides a ring, the halves thereof, when parted, present the mold firmly for manipulation; and provides a ring with rests whereby it is supported on an operating table.

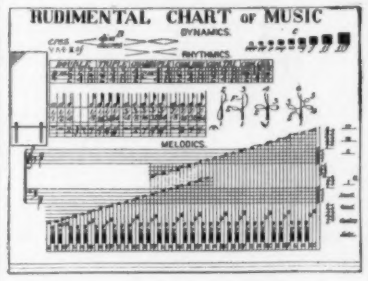
LETTER SLOT ATTACHMENT.—JOSEPH POPENHAGEN, 1342 West Monroe Street, Chicago, Ill. The letter-slot attachment here illustrated is adapted to be applied to a trunk, so that the owner of the trunk, on leaving for a trip, may instruct a suitable person to



LETTER SLOT FOR TRUNKS.

deposit all mail which may come for him during his absence, in the trunk, where there will be no danger of its being lost or tampered with. The slot opening is provided with a spring-pressed guard, which closes automatically and prevents the intrusion of dust or other matter into the trunk.

MUSIC TEACHING DEVICE.—O. NELSON, Route No. 2, Axtell, Nebraska. This invention provides an improved method of teaching the rudiments of music, particularly transpo-



MUSIC TEACHING DEVICE.

sition, by the use of slides bearing characters denoting the intervals of the gamut or diatonic scale, the slides being movable relative to the representation of a keyboard, the keys of which are aligned with the corresponding notes on a staff, and movable signature cards bearing the signatures of the different keys, which are adapted to be placed in alignment with the staff lines.

KEY RING.—J. A. PRIGGE, JR., 112 Hudson Street, New York. It is quite an advantage to be able to separate the keys that one carries with him into two or more groups, so that they may be readily accessible when desired. The accompanying engraving illustrates a key ring in which such a division is made possible.

KEY RING.

One section of the ring may be used for office keys and the other for house keys, so that when selecting a key, it will not be necessary to fumble over the entire set before finding the desired one. The key ring is very simply made, as shown, of a single length of wire, the ends of which are located within the ring where they are not liable to catch and tear the pocket.

SAW SET.—J. C. MILHOLLAND, Oklahoma, Okla. The object of the invention is to provide a saw-set, arranged to accurately and quickly set a plurality of teeth at the same time, successive teeth standing in opposite directions. If the length of the saw exceeds the length of the dies, the former is shifted correspondingly over the support, to engage another set of teeth.

DISCHARGE HEAD FOR COLLAPSIBLE TUBES.—OSCAR GERDTZEN, Casilla 1127, Valparaiso, Chile. An improvement in tubes used for dentifrices in the form of cream or paste is here provided. The tube is similar to the type now in use, with the exception that the discharge head is made relatively long and narrow and the paste is discharged through a set of perforations in the head, the perforations being so closely spaced as to form practically a solid ribbon of paste. The discharge head is of cylindrical form, and over it is fitted a spring casing that serves as a cover, a knob being provided to facilitate removing and applying the cover.

HOLDER FOR GRINDING TOOLS.—C. S. MASON, Hershey, Neb. This improvement provides means for holding in guided relation with a grinding tool, a cutting blade; provides a holder wherein may be accommodated the blade of a mowing machine sickle; provides efficient and rapid clamping means for the blade; and provides adjustments for varying the operative position of the blade holder.

Hardware and Tools.

NUT LOCK.—L. K. WATROUS, Sea Cliff, N. Y. The invention refers to nut locks, the special purpose being to provide a construction wherein a nut is mounted upon a sleeve, and the sleeve in turn is mounted upon a bolt, and so arranged that in consequence of pressure of the nut upon the sleeve none of the parts can move readily to other parts.

DOOR LOCK.—A. J. HELMS, Portland, Ore. This invention is an improvement in door locks and the object is the provision of a lock operated by a knob, and normally retained in locked position by a tumbler, the tumbler preventing the use of the knob until released by a key. One or more tumblers may be made use of as desired.

CLOTHES-LINE SUPPORTING DEVICE.—V. A. ROUILLIARD, Fall River, Mass. The invention relates to a class of line supports that are arranged at a window for supporting an endless clothes line at the window and at a distance, so as to enable the hanging of clothing or other washed fabric on the line adjacent to the window, and permit the line to be moved longitudinally for a free exposition of the goods on the line to facilitate drying of the same.

PIPE-WRENCH.—T. J. NICHOLSON, Kingston, Ontario, Canada. In this invention use is made of a pair of pivoted handles terminating in a circular head adapted to detachably receive jaws having bearing surfaces for safely gripping polished pipe and springs secured to the handles, and adapted to engage the jaws to hold the same in operative position in the head.

SAFETY-RAZOR.—L. N. LEVINSOHN, New York, N. Y. The intention of the present patent is to provide a razor arranged to accommodate different makes of thin, flexible blades, and to permit ready stropping of the blades and adjustment of the latter relative to the guard, for close shaving. It relates to razors such as described in Letters Patent of the United States formerly granted to Mr. Levinsohn.

VISE FOR DRILL PRESSES.—A. JOHNSON, New York, N. Y. This vise involves a base plate which may be temporarily clamped to the table of the drill press or may be held in position by hand. The plate is provided with a jaw and a slide having a second jaw, which may be moved toward and from the first jaw by reciprocation of the slide. It can hold any small object which it drills. Auxiliary removable jaws hold objects of larger size and of different character.

HAME AND TRACE CONNECTOR.—B. M. WILHITE and L. OBERWETTER, Gordon, Neb. This invention provides a connection whereby the pull is received upon the hames and collar directly in the line of draft; provides a draft connection for the hames which may be shifted vertically to change the line of draft; provides a connection which avoids all twisting strains upon the hames; and provides a connector for the hames which may be quickly adjusted in position and locked therein.

POST-HOLE AUGER.—R. T. JENNEY, De Pere, Wis. The improvement pertains to augers such as are used in boring holes in the ground to insert posts or poles, or for similar purposes. The device belongs to a type presenting two oppositely disposed blades which are formed at their lower extremities into cutters or knives which cut through the earth when the device is revolved.

COMBINATION BLIND, LOCK AND CATCH.—W. J. D. BRANSCOM, Mobile, Ala. The purpose of the invention is the provision of a device which, while simply constructed and resembling the ordinary catch in appearance, may be locked to prevent opening of the blind. The key must be inserted from within, that is, the inner side of the blind, so that there is no possibility of tampering with the lock when the blind is closed.

LOCK.—J. A. FREMON, Leeper, Mo. This invention relates to locks of a type embodying a slide bolt and pivoted tumblers as elements, and has for its object to provide a construction for a lock and a special key therefor, which render the lock very secure and adapt the mechanism for an exposure of attempts to unlock the lock without a proper key.

WRENCH.—J. A. OVERLANDER, White Plains, N. Y. In the present patent the invention has reference to an improvement in nut, pipe, or so-called "monkey," wrenches which comprise opposing jaws attached to different shanks that are adapted to slide open or to close the jaws. A guard ring to avoid injury to the operator's hand is applied to the wrench.

HOSE-COUPLING.—B. MORGAN, Newport, R. I. The object of the present invention is to provide a coupling which is readily adjustable for hose of different sizes, and arranged to permit convenient placing of the coupling in position and to securely fasten the parts, such as a hose and a pipe together. It relates to hose couplings such as described in Letters Patent of the U. S., formerly granted to Mr. Morgan.

PRUNING-KNIFE.—F. A. FRUMVILLER, Detroit, Mich. The invention provides an implement wherein the pull on the latter is converted into a cutting force; provides an implement wherein the wear incident to the cutting strain is provided for; provides a construction wherein the shredding of the bark from limbs being severed is overcome; and provides a construction wherein the cutting strain introduced upon the blade is balanced.

LANTERN-HOOK.—S. GORDON, Chazy, N. Y. The invention has in view a hook in which the possible accidental disengagement of the lantern bell or other article suspended is prevented, the hook comprising a wall bracket or other attaching member having prongs extending from its opposite end portions outwardly toward the center of the bracket, with the ends of the prongs spaced apart and arranged to prevent direct engagement and disengagement of the lantern bell.

SIDING-TOOL.—H. E. THOMPSON, Wisdom, Mont. This invention provides a tool for marking siding to fit the corner board irrespective of the angle at which the inner edge thereof is cut; provides for marking boards adapted to be controlled as to the line of mark by the undercut edge of a corner board door or window casing; provides means for setting the tool to ascertain the desired thickness of corner board, door or casing and thickness and width of siding or clapboarding.

WHIP-RACK.—P. H. SHAFER, Ingram, Wis. The object in view in this instance is to provide a rack to hold a whip in such manner as to keep it straight, the whip being suspended from near the tip and a whip may be slipped into or removed from the rack in a dark room by sliding the whip along the wall with a slight upward motion.

DEVICE FOR DETERMINING DIAMETERS.—J. G. AYERS, JR., Steelton, Pa. This invention relates to certain improvements in measuring devices, and the object of the inventor is the provision of a device whereby the diameter of a cylindrical bore or the radius of a curved surface may be readily ascertained.

WINDOW FASTENER.—C. M. BERRY, New York, N. Y. For the purpose of this invention, use is made of a screw rod screwing in a nut mounted to swing in a bearing plate attached to the frame at a point immediately above the top of the lower sash at the time the latter is closed, so as to permit of extending the screw rod across the top of the lower sash, and thus lock both sashes against opening from the outside.

DOOR-SECURER.—R. E. HUTCHINSON, Portland, Ore. This invention has reference to a new and improved keyless door lock, which may be carried in the pocket on a key ring and be ready for instantaneous use by a person traveling about from place to place in strange houses where locks and keys are not always provided.

HANDLE.—E. C. BLACKBURN and J. MICHAL, JR., Goldfield, Nev. This invention is an improvement in handles, and the aim is to provide a removable handle adapted to be applied to the open ends of vessels, such as the ordinary five-gallon oil can, and which handle can be quickly secured in place and as quickly removed and applied to another can.

WRENCH.—E. L. BROWN, Wabuska, Nev. The invention may be embodied in its broad principles in a monkey wrench in which the fixed jaw has the shank pivoted to the handle, which latter has the crank projection connected by a screw with the sliding jaw, certain parts operating as in the other parts of the wrench, but the faces of the jaws being smooth so they may operate upon a square or other angular nut. The jaws can be clamped by the rocking handle upon a nut thus avoiding in a measure the marring of corners on other portions of a nut.

SAW-SET.—C. H. BISHOP, El Reno, Okla. In the present patent the invention comprises broadly gripping jaws, each having a gripping surface for holding the saw, one jaw having an inclined surface at the end of the gripping surface, and the other a block for co-operating with the inclined surface and resiliently mounted on the jaw.

Heating and Lighting.

BOILER-FLUE.—J. R. CROWLEY, Atlanta, Ga. The invention provides flue tubes which are made in longitudinal sections telescoping each other at their inner ends, and suitably secured at their outer ends to their respective flue sheets. They may be secured to their flue sheets in any suitable manner, and by telescoping at their inner meeting ends they permit the tubes to expand and contract longitudinally without exerting any substantial strain upon the flue sheets.

FURNACE.—B. L. WORTHEN, Tucson, Ariz. The invention pertains to furnaces, the more particular object being to improve the construction of furnaces and to facilitate the removal and replacement of twyers employed thereupon. It further relates to certain mechanism for compensating the expansion and contraction due to varying degrees of heat.

Household Utilities.

HAND-RUBBER.—M. ANGERT, New York,

N. Y. This invention pertains to certain improvements in hand rubbers for use in washing clothes, and more particularly to that type of rubber which presents a roughened under surface and which is adapted to contain the soap or other detergent and to deliver the same to the material being washed.

SASH-CORD FASTENER.—A. M. WOERNER, New York, N. Y. In the present patent the invention has reference to sash cord fasteners, and has for its object the provision of a new and improved fastener which is simple and inexpensive and by means of which the cord can be quickly and readily attached and detached from a shaft.

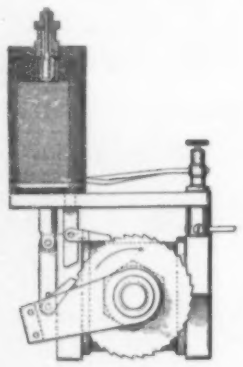
WASH BOWL AND BASIN TRAP.—A. MCINTOSH, Green Island, N. Y. This invention provides a trap the construction whereof permits a quick and ready separation for cleaning or repair; provides a trap section whereby the sediment or clogging material can be seen; and provides a connection resilient in character to relieve the pressure on the bowl to which the traps are attached.

Machines and Mechanical Devices.

VOTING APPARATUS.—W. A. SANFORD, Dunellen, N. J. Use is made in this invention, of ballots in the form of disks or the like, colored differently as to parties, and adapted to be placed by the voter into a ballot carrier, having means for receiving the ballots as to the different offices to be voted for. The carrier, after being filled by the voter, is placed on a stand and actuated, so as to drop the ballots into receptacles according to offices to be voted for.

MIXING-MACHINE.—A. F. NIMS, Philadelphia, N. Y. The machine is for use in mixing concrete and similar material, and the invention relates more particularly to a mixing machine comprising hollow, communicating sections arranged so that they can be revolved, and having an inlet and an outlet, partitions being provided within the sections, which serve to direct the material passing through the same.

VALVE.—J. B. DAVIDSON, 722 Colorado Street, Butte, Montana. The mechanism illustrated herewith is intended to regulate the extent of opening of a valve, and to hold a valve at this open position indefinitely. It comprises a ratchet mechanism in combination with a solenoid. The ratchet wheel is mounted on the valve stem, and when the current is admitted to the coil of the solenoid, the core is drawn upward, turning the ratchet wheel and partially opening the valve. When the current is cut off, a weight operates to draw the core downward, without, however, closing the valve. By repeating this action, the valve may be opened to any degree desired.



VALVE REGULATOR.

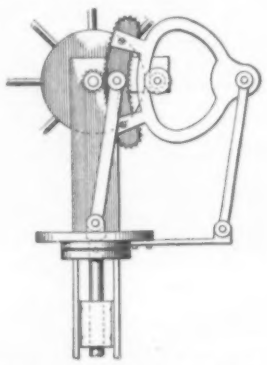
MEANS FOR ATTACHING SEALS TO PACKING-CASES.—S. STROH, 30 Allerton road, Lordship Park, London England. This invention provides improved means for attaching packing cases. According to the improvement a strip of metal cut and shaped to form a supply of seals connected together by narrow necks of metal, is automatically fed through the device, and a stock of pins is so arranged that after each operation a fresh seal and a fresh pin are in position for use.

VALVE-FITTING.—J. F. BERNSTEIN, New York, N. Y. The object here is to provide a fitting for attachment to certain vessels, and arranged to permit convenient filling of the vessel with water and gas, to form a charged liquid, to allow transportation of the vessel and contents to a soda water fountain or other apparatus, and to discharge the contents of the vessel into the fountain and to allow refilling of the vessel with water and gas without removing the fitting.

SEWING-MACHINE.—W. PEPPERLING, Two Harbors, Minn. The invention relates to sewing machines wherein when the thread of the shuttle is exhausted a new supply will be automatically introduced. The shuttle thread normally engages with a spring and as long as there is thread in the first the spring maintains the part in normal position. When the threads in the shuttle are exhausted the spring is released and throws into operation the means for bringing into play the new supply.

FRICTION CLUTCH-PULLEY.—A. S. ANDERSON, Elliott, Ill. The invention provides means which permit of the pulleys' ready adjustment to different speeds. It provides an equalizing means for the weights mounted on the arms of the levers, to make certain that a perfect balance of the pulley is obtained.

DRIVING MECHANISM FOR PUMPS.—T. G. SMITH, Box 33, Bloemfontein, Orange River Colony, South Africa. A novel mechanical movement has been invented by Mr. Smith for translating rotary motion into reciprocatory motion, particularly for use in applying the power of a windmill to a pump. The windwheel carries a pinion which engages a concavo-convex gear, reciprocating the latter, which is connected to the pump rod. The concavo-convex gear is held in engagement with the pinion at all times by means of a cam and roller.

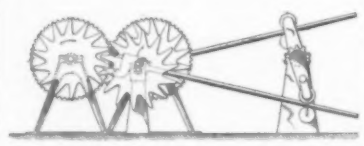


DRIVING MECHANISM FOR PUMPS.

FILLER-MACHINE.—G. R. KENDRICK, Portland, Ind. The improvement relates to a machine for making fillers for packing cases such as egg boxes. These fillers are formed of strips disposed in parallel rows and extending transversely of each other so as to form separate compartments for the individual articles packed in the packing case.

SHUTTLE.—T. J. CARISIO, Allentown, Pa. The invention relates to shuttles, the more particular purpose being to provide the same with means for cutting a filling thread by a positive chopping motion, this motion being controllable by the tension of the filling thread and independent of the ejection of the filling carrier from the shuttle.

DRIVING MECHANISM.—A. E. H. J. THOELLDEN, 109 Foster Street, New Haven, Conn. The object of the mechanism here illustrated is to provide means for driving a power shaft from a crank shaft through levers and ratchet wheels, the ratchet wheel being fixed to the power shaft and the levers operatively connected to the crank shaft to swing oppositely. The levers are furnished with means for engaging the teeth of the ratchet wheels to drive the power shaft. This is an improvement on a previous invention that permitted the power shaft to revolve faster than it was driven by the levers, which was objectionable when the mechanism was applied to a vehicle, as when the latter was running down grade. The present invention does not permit of such motion during coasting.



DRIVING MECHANISM FOR SHAFT.

CONTROLLING MEANS FOR AEROPLANES.—P. DANIEL, Perth Amboy, N. J. The invention pertains to certain improvements in controlling means for aeroplanes, and more particularly to certain improvements in the positioning of the guiding, steering and balancing rudders and planes, and to the means for operating these independently or simultaneously from a single controlling member.

ATTACHMENT FOR POWER PRESSES.—J. G. BENSTER and H. L. BENSTER, Moline, Ill. In this instance the invention refers to attachments for power presses, such as are used for punching structural steel I-beams, channel beams and like articles, and its aim is to extend the range thereof and to permit straightening, bending, twisting or untwisting of a beam or a similar article, in a simple, economical and accurate manner.

THREAD-CUTTING SHUTTLE.—T. J. GARISIO, Allentown, Pa. In this patent the inventor seeks to mount directly upon the shuttle a cutting mechanism which is actuated by the tension of the filling thread, and so arranged as to sever this thread whenever the tension of the latter exceeds a predetermined limit.

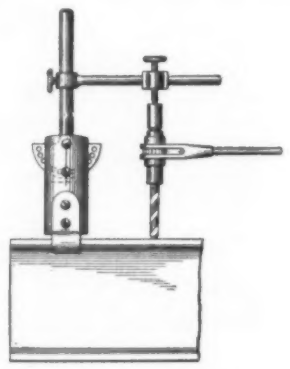
BOTTLE-WASHER.—D. NEILLY, Bradford, Pa. The invention provides a mechanism for washing bottles wherein is prevented the lateral discharge of water incident to the usual employment of a bristle brush; provides for holding a bottle during the washing; provides a shield for the rotary brush for washing bottles, to prevent the distribution of the water contained in the brush, and economizes and simplifies the construction of machines employing rotary cleaning brushes.

LATCH-CONTROLLING DEVICE FOR CLUTCH MECHANISMS.—C. O. BERGMAN, Evanston, Ill. In this case the invention relates to clutch mechanism, such as are employed upon punching and shearing machinery, the more particular purpose being to provide means for positively locking and unlocking a latch used for controling the clutch pin or analogous member used for stopping and starting certain movable parts.

FRICTION-GEARING.—L. N. LACOMBE, New York, N. Y. This invention pertains to certain improvements in friction gearing for positively connecting driving and driven shafts, and more particularly to that type in which the driven shaft may be rotated in either direction in respect to direction of rotation of the driving shaft.

SHUTTLE.—W. N. REIFF and J. A. KRAUSS, East Greenville, Pa. The object of the invention is the provision of a new and improved shuttle, more especially designed for use in silk ribbon looms, and arranged to tear the filling thread in case the shed is not fully open or clear, owing to extraneous matter causing a tangle of some of the warps.

ADJUSTABLE POST FOR RATCHET DRILLS.—CHARLES B. HASTINGS, 371 Pleasant Avenue, New York. The holder shown in the accompanying engraving is adapted for ratchet drills such as are used largely in steel construction. It comprises a post fitted with clamps by which it may be secured to a beam, and mounted in this post is a rod that may be swung to any desired angle and be secured. Projecting at right angles from this rod is an arm fitted with a slide, in which is a set screw adapted to bear against the head of the ratchet drill. By this means the post may be secured to one face of an angle, and the drill applied to another face, even though it be not at a right angle thereto.



ADJUSTABLE POST FOR RATCHET DRILLS.

CARRIAGE-FEEDING DEVICE FOR TYPEWRITERS.—H. L. W. F. KLEMP, 32-35 Hollmannstrasse, Berlin, Germany. This invention relates to improvements in carriage-feeding mechanism for typewriting machines, whereby the carriage may be moved a two-letter space instead of a single-letter space at each type impression. This movement is effected by limiting the intermittent rotation of the escapement wheel which is operatively connected with a pinion that constantly meshes with the carriage rack bar.

LACE-TIPPING MACHINE.—W. H. JOSLIN and M. H. BENNETT, Sciute, R. I. In this machine the lacing is carried as a continuous length past a tip-applying mechanism, where a metal blank is wrapped about it at successive points spaced apart equal to length of lace required and each blank severed to form two laces, the finished laces being bunched into lots for removal. The tip-applying mechanism embodies punching and bending dies, and cutters for the metal ribbon from which tips are formed and means for performing its proper function, and means to retain driving mechanism whereby when the ribbon is exhausted the mechanism will be released and the machine stopped.

STEAM-TRAP.—V. B. CONVIS, Toronto, Ontario, Canada. This invention is an improvement in automatic steam traps in which the opening and closing of the water-release valve depends upon expansion and contraction of a brass steam tube co-acting with a lever that is connected directly with the valve stem, and whose vibration, due to changes in temperature of the tube, operates the valve; and the objects are to increase the sensitiveness and to reduce the cost of this type of traps.

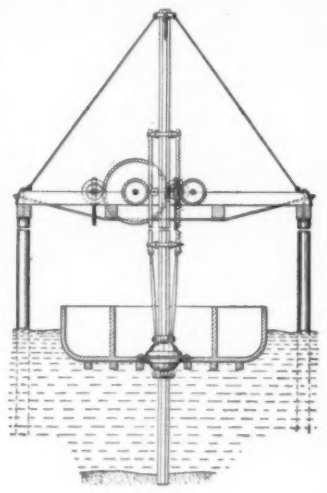
EXPANDING CHAIN WHEEL.—W. L. MONTAGUE, Belmont, N. Y. This wheel is of the expanding or compensating type, in which the distance of the teeth from the center may be varied for various purposes. An object is to provide a wheel having teeth capable of being adjusted to various distances from the hub, with means for locking the teeth in their adjusted positions.

APPARATUS FOR MACHINING PIPE ENDS TO FORM SPIGOT AND SOCKET JOINTS.—T. HARDEN, 62 Hurlingham road, Fulham, London, England. Mr. Harden's invention has reference to an improved tool for forming conical spigot and socket ends on lead or other tubes and pipes, with the object of enabling such tubes or pipes to be rigidly jointed together by means of a solder or otherwise without alteration to the cross-sectional area of the bore.

ADDING-MACHINE ATTACHMENT. — C. L. DOWNER, Idaho Falls, Idaho. This invention relates to attachments for adding machines and like devices, and has reference more particularly to an attachment of this class, comprising means for operating by foot-power, the hand-crank, or other like manipulating member of the adding machine.

Prime Movers and Their Accessories.

WAVE MOTOR.—THOMAS NIXON, 815 Chapala Street, Santa Barbara, Cal. For the purpose of utilizing the power of the waves, Mr. Nixon has devised the construction shown in the accompanying illustration, consisting of a pier or other stationary support, in which is affixed a shaft or mast extending down into the water. Mounted to slide on this shaft is a vessel which carries rack-bars adapted to operate pinions of a gear train. The vessel is free to oscillate on the shaft as well as to move up and down, and all such motion is converted into rotary motion by means of the rack and pinion gearing.

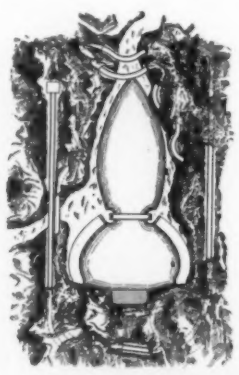


WAVE MOTOR.

ECCENTRIC FASTENING.—F. P. SASAMAN, West Pittston, Pa. The invention provides a key for the eccentrics of a locomotive, which will fasten an eccentric to the axle, so that it will not work loose or slip, and yet may be removed easily when necessary to make repairs. The key-way may be machined as readily for this key as for the old gib key, and with no more expense. It does away with compression set screws. The splice keys will not be subject to the strain of the set screws, but will only have to hold the smaller part of the eccentric to the greater part to form the circle. The device can be applied to old eccentrics as well as new.

Pertaining to Recreation.

AMUSEMENT APPARATUS.—E. KOHLER, Alameda, Cal. This apparatus belongs in the class of scenic railways. The cars, however, are circular in form, and are mounted on swiveled wheels or castors, so that they may rotate at times aside from moving along a path, which is curved and inclined in the usual way and bordered with various scenic effects viewable from the cars. Illumination devices are provided, designed to give the passengers in the cars the impression of traveling in subterranean or shaft-like passages.



AMUSEMENT APPARATUS.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

The weekly *Index of Patents* issued by the *United States Patent Office* will be found in the *Scientific American Supplement*.

Notes and Queries.

Kindly write queries on separate sheets when writing about other matters, such as patents, subscriptions, books, etc. This will facilitate answering your questions. Be sure and give full name and address on every sheet.

Full hints to correspondents were printed at the head of this column in the issue of June 18th, 1910, or will be sent by mail on request.

(12346) I. R. says: Kindly help me in solving a little mechanical problem, namely, I claim if a railroad car is turning a curve, the outside wheel is making more revolutions than the inside wheel, that is, if the wheels are loose on the axle; but if solidly attached to the axle, they make the same revolutions, but the outside must skid or glide. My opponent says this: That the wheels on both sides make the same revolutions whether loose or attached to the axle and without skidding. A. An editorial article in the SCIENTIFIC AMERICAN of May 27th, 1905, vol. 91, No. 21, price ten cents, gives a full discussion of the behavior of a pair of car wheels in rounding a curve. It is therein stated that the inner rail is of necessity shorter than the outer rail of a curved track, since it is struck upon a radius of 4½ feet shorter. Now if the two wheels are fixed to the axle, as is usually the case, it follows that either the inner wheel must slip backward on the shorter inner rail, or the outer wheel must slip forward on the longer outer rail, for they must make the same number of turns, in the same time, but go an unequal distance over the rails. If the wheels are loose on the axle, the outer wheel will make a greater number of turns than the inner, if both run without slipping, since it goes over a greater length of track.

(12347) P. D. R. asks: Have you published in the SCIENTIFIC AMERICAN SUPPLEMENT details of the more prominent aeroplanes? A. In SUPPLEMENT Nos. 1816, 1817, 1818, 1819, 1820, 1821, and 1822 is published "The Practice and Theory of Aviation," by Grover Cleveland Loening, A.M. This is the most compact paper on aeroplanes that has probably ever been published. Fourteen biplanes and monoplanes are described in detail, and illustrated with scale drawings, namely, the Farman, Cody, Curtiss, Wright, Voisin (old model), Voisin (new model), and Sommer biplanes, and the Antoinette, Santos-Dumont, Blériot XI, Blériot XII, Grade, Pelterie and Pfitzner monoplanes. The proper dimensioning of aeroplane surfaces, as deduced by famous experimenters from their tests, is also considered. Taken as a whole, this series of seven papers constitutes an admirable text book. Price, 10 cents each; 70 cents for the set mailed.

(12348) J. J. F. asks: Will you please tell me the number of pounds pressure required to compress air to 2/3 and also 1/2 of its volume? A. For 2/3 volume, use 3/2 pressure; for 1/2 volume, use 2/1 pressure. As free air has the atmospheric pressure of 14.7 pounds per square inch, the pressures are 22½ pounds above vacuum or 7.35 pounds gage, and 29.4 pounds above vacuum or 14.7 pounds gage, respectively.

(12349) W. S. S. asks: What SCIENTIFIC AMERICAN SUPPLEMENT contains an article on rheostat suitable for use with electric light for stereopticon 110-volt? A. You will find valuable instruction for rheostats in our SUPPLEMENT Nos. 865, 985, and 1594, price ten cents each. For stereopticon work the rheostat is adjusted to take up the voltage above what the arc requires, and allow the amperes which the arc requires, to pass. An arc requires 45 to 50 volts; the rest of the 110 volts are taken by the rheostat. A stereopticon lamp usually employs 15 amperes. The rheostat must have resistance enough to allow 15 amperes to flow under a pressure of 55 volts. Its resistance must be 55 ÷ 15 or 3 2/3 ohms. The construction of the rheostat is fully described in the SUPPLEMENT referred to above.

(12350) V. Z. asks: When I was at school I was taught that in the ocean at a certain depth the density of the water is equal to that of steel, so that a sunk ship will rest in a suspended position; but, then the rocks of less density than steel have to rise from the bottom, as will be the case if we fill a hole in the sand with mercury. A. The teaching that water is compressible to the extent that it can be made denser than steel was certainly entirely erroneous. The fact is that a pressure of one atmosphere or fifteen pounds per square inch will compress water only 44 millionths of its volume. In the deepest part of the ocean the compression will be about one twenty-fifth of the volume. The density of steel is about seven and a half times that of water, and it is one and a half times as compressible as water. All metals are more compressible than water. Stones will never rise under water.

(12351) I. R. says: When I was seven or eight years of age, and the cooking was done in a fireplace, two boys would take the tongs and rub a knife with them and then would lift a nail with it. They said it magnetized the knife to rub it with the tongs. Could such a thing be done? A. A knife blade or any piece of steel can be magnetized by rubbing it upon the steel parts of a pair of tongs. The reason is that the tongs become magnetized by the earth. All iron or steel standing upright, or nearly so, becomes magnetized in a short time. Iron fence palings, crowbars, iron pillars, etc., will all be found to be magnets with the north poles toward the earth, and their upper ends will be south poles. The earth acts as if it were a great magnet. It is this magnetism of the earth which directs the compass needle, and it can make other magnets as well.

(12352) F. J. T. asks: Will you explain the *modus operandi* of the maximum and minimum self-registering thermometer? I have one, and cannot find in any work at hand a satisfactory explanation of the law governing its operation. A. There are a number of kinds of registering maximum and minimum thermometers. We think yours may be the one with the tube bent so that three lengths of tube are side by side. This is called a Six's thermometer, from the name of its inventor. The larger part of the tube hangs down and is filled with alcohol. The U-shaped part of the tube is filled with mercury, which joins the alcohol at one end of the thread of mercury and is covered with alcohol at the other end. Above the alcohol at this end is an empty place, which allows the expansion of the contents of the tube. The alcohol in the large part of the tube is the liquid which expands and contracts as the temperature rises and falls, thus moving the thread of mercury along. Above the mercury at each end are steel needles, which show the highest and lowest points reached by the mercury, and which are drawn back to their places by a magnet when the instrument is set. 2. Suppose a thermometer frozen in a cake of ice in zero weather. Will it register the outside temperature or less? A. A thermometer frozen into a block of ice will register the temperature of the ice. If the air about the ice is above freezing, the thermometer will register 32 deg. F.; if the air is below freezing, the ice will gradually cool as any other stone would do, and the thermometer will register the temperature of the interior of the block of ice. In time this would be the same as that of the external air—zero in the case you propose. Ice is a poor conductor of heat, having according to some good authorities from four to five times the conducting power of water, and about one five-hundredth the conducting power of copper, so that the cooling would be slow but still real, and the ice in time will have the same temperature as that of the surrounding air, if the air is below freezing. Ice cannot be heated above 32 deg. F. without beginning to melt.

(12353) P. P. E. asks: Will you kindly give me a process for gold or silver electroplating in a small way? Will a 6-volt 60-ampere storage battery be large enough, or can I use a 110-volt alternating current? A. The process of electroplating in a small way is described in the SCIENTIFIC AMERICAN, vol. 103, No. 26; price 10 cents. You will find a 6-volt storage battery adapted to such work. You may require a rheostat to cut down the amperes when small pieces are plating. You will find many valuable papers upon electroplating in our SUPPLEMENT, a catalogue of which we send you, and shall be glad to fill any orders you may send at 10 cents per copy.

(12354) E. F. D. says: I would greatly appreciate your telling me what are the periods in notation above vigintillions, which I believe is the twenty-first period from units. In what case would any great part of twenty-two or more periods be likely to be used? A. We have never seen any name for the twenty-first period of decimal numbers in Arabic notation. As the names follow the Latin numerals, it would be expected that the names for periods would be made from the Latin names above twenty. Twenty-one is *unum et viginti*, etc. It might be that a name such as *unum et vigintillions* would answer the purpose. We do not know where you could find a use for any such number. All large numbers are now expressed as powers of 10. We never think of the name of such numbers; 4.19^{21} means that 21 ciphers are to be attached to the significant figures and the decimal point is to be moved 21 places to the right.

(12355) E. B. S. asks: I have a little curiosity to have a matter explained to me; possibly it may be of interest to your readers. My wife employs the following method of cleaning her silver: She puts the tarnished silver in water heated to the boiling point in an aluminium kettle. In a few minutes the silver is absolutely bright, and no traces left of the tarnish, even when it was black from eggs or from being in a room in which sulphur was present. I am curious to know whether it is an electric or chemical action that takes place under the circumstances, and just what the action is. A. The action between the silver and the aluminium dish is electrical. An electrolytic action causes the surface of the silver to be removed and a fresh surface of silver is left.

(12356) A. W. B. asks: Is a metal roof on a wooden building any protection from lightning? A. A metal roof on a building is a protection from lightning if it is properly grounded at all the corners, otherwise it is a menace to the building. See our SUPPLEMENT Nos. 1503, 1525, 1581, 1582, 1583, 1584, 1604, price ten cents each, for valuable articles upon the modern use and construction of lightning rods.

NEW BOOKS, ETC.

HUNTING WITH THE ESKIMOS. By Harry Whitney. New York: The Century Company, 1910. 8vo.; 453 pp. Price, $3.50.

This is a unique record of a sportsman's year among the northernmost tribe—its big game hunting, the native life, and the battle for existence through the long Arctic night. It is illustrated with photographs by the author and is a timely and sumptuous book. Mr. Harry Whitney has brought out of the Arctic a remarkable and absorbing narrative of thrilling adventures and unusual experiences. It is a narrative unlike any other description of Arctic life and travel. It is a distinctive and valuable contribution to the literature of the region. Not only will it interest and hold the sportsman and lover of wilderness adventure, but from an ethnic standpoint it contains much that is new concerning the Highland Eskimos, the most northerly inhabitants of the earth. The chief feature of the narrative, however, is adventure. The imaginative writer could hardly picture more thrilling incidents and hairbreadth escapes than fell to the lot of Mr. Whitney and his Eskimo companions on their hunts for bear, walrus, or musk-ox, on the trail; on the sea, or at times when they were overtaken by the fearful storms and hurricanes characteristic of the region. Hardly a chapter but contains an unusual adventure. Mr. Whitney is a very modest man, however, and in his record he has so undervalued the hazard and peril of many of the positions in which he was placed, that one must read between the lines to fully appreciate them.

KARANOG, THE ROMANO-NUBIAN CEMETERY. By C. Leonard Woolley and D. Randall-Maciver. Philadelphia: Egyptian Department of the Museum of the University of Pennsylvania, 1910. 4vo.; 115 plates.

This beautiful monograph is the fourth volume of the researches of the Eckley Coxe, Jr., Expedition to Nubia. The volume before us contains some of the most beautifully executed plates that we have ever seen in a work on archæology, and gives an entirely new view of the ancient civilization of this interesting but little studied section of the world. The coins, the glass vessels, the glass and stone beads, the pottery, all show an extremely decorative art which in many cases transcends the primitive. The book will be of great value to all archæologists.

THEORETICAL MECHANICS. By Percy F. Smith, Ph.D., and William R. Longley, Ph.D. New York: Ginn & Co., 1910. 288 pp. Price, $2.50 net.

This work takes up the mathematical side of mechanics, and presupposes a knowledge on the part of the student of mathematics as far as calculus and of the fundamentals of general physics. The work is based upon the experience of the authors in teaching theoretical mechanics in the Sheffield Scientific School of Yale University. The text has hitherto been used in mimeographed form.

OLD ENGLISH INSTRUMENTS OF MUSIC. By Francis W. Galpin. London: Methuen & Co.

The Rev. Francis W. Galpin's name is well known to antiquaries in this country, partly because of the assistance which he gave in arranging and cataloguing the old musical instruments in the Crosby-Brown collection of the Metropolitan Museum of Art. From so distinguished a student in the domain of antique musical instruments, we cannot but expect a work of authority, and this expectation Mr. Galpin has fulfilled in the book before us. The subject is so vast in extent that it is difficult indeed to compress, as Mr. Galpin has done, in a space of 314 pages, and in a form which would satisfy both the general reader and the student, an amount of material which is truly enormous. Although the book is confined almost entirely to English musical instruments, it goes without saying that it is applicable to European antique musical history in general. In a perusal of the painstaking treatise of Mr. Galpin, one cannot but feel that our stock of useful books is decidedly enriched.

PRINCIPLES OF WIRELESS TELEGRAPHY. By George W. Pierce, A.M., Ph.D. New York: McGray Hill Book Company, 1910. 350 pp.; 235 illustrations. Price, $3 net.

One would suppose that there were books a-plenty on the subject of wireless telegraphy but there seem to be very few books written by an author who does not display a bias for some particular system of wireless telegraphy. One might almost be led to suppose that each wireless telegraph company had its own writer describing its own system in a particularly favorable light, and possibly to the detriment of other systems. No such taint is observable in the present work. The volume is made up from a course of lectures on Electric Waves and Their Application to Wireless Telegraphy, given to classes at Harvard University. Only the non-mathematical portions of this course are here published, the object being to introduce the subject in an elementary way as far as possible, to discuss the properties of electric waves and oscillations, and the general principles and methods of electric wave telegraphy for the benefit not only of the amateur and the student, but for the professional man as well.

THE BOY AVIATORS IN RECORD FLIGHT; OR THE RIVAL AEROPLANE. By Capt. Wilbur Lawton. New York: Hurst & Co., 1910. 16mo.; 266 pp. Price, 50 cents.

This is the last of a series of six titles for boys dealing with aviation. The book reeks with gasoline and is filled with information as to chassis, planes, gyroscopes, and other things dear to the heart of the aerial fan. The present volume deals with a transcontinental trip. It is quite within the bounds of possibility that such a trip may be made in the near future by some of the boys' elders. The book contains about all the blood and thunder that is good for a boy to have, but is a vast improvement over the literature of adventure for the boy of fifteen or twenty years ago.

THE RELATIONS BETWEEN CHEMICAL CONSTITUTION AND SOME PHYSICAL PROPERTIES. By Samuel Smiles, D.Sc. London: Longmans, Green & Co., 1910.

Dealing, as it does, with the chief physical properties of the elements and their compounds, the book is a great help in discovering just what has been done in this field. The introductory discussion of the nature of each physical property in turn is admirable. The lesson which the author teaches is that only by a more perfect solution of the problem of valency can we make any further advances, with which statement, no doubt, most chemists are willing to agree. It is difficult to prepare a book upon so vast a subject with anything like a proportionate relation of part to part, particularly when it is written from the standpoint of organic chemistry. To increase the utility of the book for purposes of reference, the chapters dealing with each physical property have been subdivided into sections which deal with successive portions of the subject.

HISTORY OF CHEMISTRY. By Sir Edward Thorpe. New York: G. P. Putnam's Sons, 1910.

In this admirable little book Sir Edward Thorpe has given us a remarkably interesting account of modern chemistry. Beginning with the state of chemistry in the middle of the nineteenth century, in which he comments on the work of Frederick Wochler, he passes to the discovery of the chemical elements by means of the spectroscope. Next comes a very simple account of radio-activity; then a discussion of atomic weights and equivalents; the molecular theory of gases; the periodic law; valency; the chemistry of aromatic compounds; stereoisomerism and stereo-chemistry, and organic synthesis. The last chapter is a good *résumé* of the development of physical chemistry since 1850.

THE ART OF THE MUNICH GALLERIES. By Florence Jean Ansell and Frank Roy Fraprie. Boston: L. C. Page & Co., 1910. 12mo.; 448 pp. Price, $2.

This volume is uniform with the others in the series entitled "The Art Galleries of Europe." The present volume is to be a history of the progress of the art of painting, illuminated and demonstrated by critical descriptions of the great paintings in the Munich gallery. The section relating to the Schack collection is interesting, as the books on painting do not usually take in this gallery. Shortly after Schack's death in 1894, the gallery was hung in his late palace, which was rearranged for the purpose, and the collection has now been removed to the new building, which was opened late last year, opposite the Bavarian National Museum. The collection of copies in this gallery is remarkable. The authors make the curious statement that in this gallery are represented a few more "painters who tried to be artists." Böcklin's famous Villa on the Sea (*Villa am Meer*) is in this collection. Fifteen years ago a book as handsomely illustrated as the present one would have been a novelty. The book merits a wide sale both on account of literary merit and good clothing. As is customary with these progressive publishers, they have given the book a most appropriate binding.

MECHANICAL DRAWING FOR PLUMBERS. By R. M. Starbuck. New York: The Norman W. Henley Publishing Company, 1910. Price, $1.50.

This is not the first book that Mr. Starbuck has produced on plumbing. His "Modern Plumbing Illustrated" and "Standard Practical Plumbing" have been very well received in the trade. In this new work of his he has supplied a want that has long been felt by the practical plumber; in other words, he has given us a simply worded book on the manner of making drawings for plumbing purposes, and told how they may be effectively used. The drawings in the book are large and clear.

DIE BEHANDLUNG UND VERWERTUNG VON KLARSCHLAMM. By Dr. Alexander Elsner. Leipzig: Verlag von Wilhelm Engelmann, 1910.

(*Continued from page 72.*)

time, but as the outside is much larger than the inside, it is found that the surface on which the flame is burning is very rapidly diminished, so that the pressure falls off very quickly as the projectile moves forward in the bore of the gun. The projectile, of course, is always traveling with an accelerated velocity; consequently, it is necessary to have some powder in which the surface actually exposed to the flame is increasing rather than diminishing, so as, in a measure, to keep up the pressure as much as possible in the gun. These multiple perforations lend themselves admirably to this purpose. . . . We regard this new product as being an ideal smokeless powder. I have tested some of it with the apparatus and in the manner employed by Prof. Abel. A powder should stand this heat test for fifteen minutes; the new powder stood it for thirty minutes."

The pure pyro-nitrocellulose developed by the officers of the United States navy, of which our service cannon powder is composed, could not be employed in a pure state in large guns, as is now done, and produce anything like as high ballistic results, unless made in the form of multi-perforated grains. In fact, it would be impossible to produce anything like satisfactory ballistic results, unless multi-perforated. The reason for this is that it is a dense, hard, and horny-like colloid, and does not burn sufficiently fast to be entirely consumed in a gun, unless the web thickness between burning surfaces be comparatively thin.

If made in the form of long, flat strips, they would have to be so thin that if a charge of full weight were used, the initial area would be so great as to make the initial pressure prohibitive; while the pressure would fall off very rapidly toward the muzzle. The same would be true if made in round rods like cordite. The rods would have to be made in mere threads, and initial pressures would be too great when full charges were used. Besides, long and thin flat strips and thin rods would easily break in handling and in transportation.

The present powder in the form of short, multi-perforated cylinders overcomes all of the above objections, enables the use of a hard colloid of pure nitrocellulose, obviates all danger of breakage, enables the use of full charges, which present small initial areas and produce comparatively low initial pressures for high velocities, and enables the production of higher velocities with lower initial pressures than any other powder in the world.

The Brucker Transatlantic Airship Expedition

(*Continued from page 62.*)

The boat contains a fire- and explosion-proof gasoline tank. The efficacy of this type of tank was demonstrated in the accident to "Zeppelin VI." Though the airship was burnt, the tank remained intact.

The boat has a length of 10 meters, a beam of 3.1 meters and a depth of 1.75 meters. It has a navigating and living cabin, equipped with a very complete set of aeronautical and meteorological instruments, a workshop and a large store of provisions. Its equipment includes water, anchors and drag ropes. The envelope has the usual maneuvering and safety valves, both in balloon and ballonet, made extra large for safety. It has stabilizing fins and a rudder mounted as in the Parseval ships. Directly below the envelope a light passageway is suspended, reached from the boat by a rope ladder. It gives direct access to the envelope and the valves, and serves also as additional "deck space."

It was first intended to start from Orotava or Teneriffe, Canary Islands. For two reasons this plan has been abandoned, as the start must be made during the first months of the year, when the trade winds are strongest and when storms do not occur in the tropical ocean. At this season the Canary Islands would be too far north, for the trade wind passes farther south at that time of the year, and barely touches Teneriffe.

Secondly, it is intended to shorten the distance to be covered as much as possible, and so the island of Saint Vincent, in the Cape Verde archipelago, has been selected as the actual starting point.

These islands are in the very heart of the trade wind; they have a very steady climate, and are exempt from thunderstorms.

It is hoped that the "Suchard," with its own speed of 18 miles, plus the steady trade wind having a minimum of 16 miles, will make at least 34 miles an hour and cover the distance, if the machinery holds out, in about five days. If there are breakdowns it will take longer, but the trade wind will insure continuous progress in any case, and there are no risks that could be in the least compared to those that Wellman faced. On this peaceful stretch of water steamers have occasionally taken in coal in mid-ocean from colliers with the same ease as in port. It should be easy to launch the motor boat in the water, if the gas bag for any reason should have to be set adrift. Having the gasoline tank right aboard, and with two 200 horse-power motors, it should prove as safe as a steamer. The whole equipment, moreover, is located in the boat from the outset, and does not have to be transferred, as in Wellman's craft.

It goes without saying that all the resources of maritime navigation will be used to keep the course exactly. The ship is now being assembled in the large, new air docks at Kiel, where it will be christened with impressive ceremony.

The Diet of Athletes

(*Continued from page 64.*)

"The idea of applying Siegfried's diet and mode of life to other pupils immediately suggested itself, but it proved to be utterly impracticable. In most cases it was impossible to control the stomach, which simply 'struck,' and refused to perform its duty. A friend of mine so injured his stomach by four successive suppers *a la* Siegfried, that he suffered several weeks with dyspepsia.

"In similar circumstances I observed two other celebrated strong men, who ate more meat than Siegfried did, but were otherwise moderate eaters. The food provided for them in my house was always 'tasty,' however, and my experience leads me to place more value on the flavor than on the chemical composition of food.

"A fourth and very interesting example is furnished by the professional athlete, Petrus Bareuther, whose measurements, taken September 22nd, 1910, before exercise, are given below: Height 5 feet 7¾ inches, weight (nude) 167 pounds, chest deflated 37.4 inches, chest inflated 45.7 inches (an extraordinary expansion), waist 31.3, thigh 22.8, calf 15.1, right upper arm extended 14.6, right upper arm contracted 17.0, lower arm 13.5, chest over arms 52.4.

"Bareuther was a foundling and his childhood was passed in extreme poverty. His food often consisted solely of dry bread. While working in a factory for four dollars per week, he joined an athletic club. After serving his time in the army he came a professional athlete and wrestler. Now, at the age of 27, he appears to be the strongest man of his weight that has ever appeared in the athletic field, for he is the only man who has lifted a weight as heavy as his own body from the ground to arm's length above his head, with the left hand as well as with the right. The world's record in performances of this class is held by the Frenchman Vasseur, who weighs 198 pounds and has lifted 209 pounds with the right hand and 187 pounds with the left. Bareuther, weighing 167 pounds, lifted 180 pounds with the right hand and 167 pounds with the left hand, in my presence. I believe that, despite his small weight, he could equal the Frenchman's record, with a little attention to training and habits (he smoked too many cigarettes). Bareuther juggles with balls weighing 50 kilogrammes (110 pounds) with an ease that astounds experts. He is a moderate eater, and prefers simple food. The secret of his astonishing strength deserves careful study.

"On the other hand, I have known dozens of men who ate much more, and some of whom ate almost incredible quantities of meat, without acquiring anything like the strength and endurance of these four remarkable men.

"The general result of my observations is this: Every person is a law unto himself and requires certain foods, from which *his* digestive organs can best extract material and energy. The required diet varies greatly, both in quality and in quantity. The preparation of the food, the manner of chewing, the digestive powers, and certain imponderable factors exert a great but yet unknown influence. In general, that person is nearest physical perfection who can develop the greatest energy from a moderate quantity of the simplest food. Good air must be regarded as one of the most important articles of food, for strong men, without exception, have good respiratory power."—Theodor Siebert in Die Umschau.

Utilization of Solar Radiation and Wind Power

(*Continued from page 65.*)

power which the sun is sending constantly to us. In the meanwhile a vast amount of available power received daily from the sun is allowed to go to waste, and our supply of coal is diminishing.

The prospect of a time, not very far distant, perhaps, when our coal supply may be exhausted, has naturally turned men's attention to other seemingly inexhaustible sources of power. The first such source to be seized upon has been the power of waterfalls, and the developments in this directions are well known to our readers. But a waterfall is merely a means of indirectly tapping the energy of the sun's rays; for the sun shining upon the vast surface of the sea and other low-lying sheets of water, raises large quantities of this in the form of vapor against gravity into clouds above. These, wind-driven over land, and striking mountain ranges, are presently precipitated at a higher level in the form of rain. The water gathers into rivers, and the work done upon it by the sun in raising it from sea-level to the higher altitudes appears in the form of potential energy of elevation. In the natural course of events this energy is gradually degenerated, converted first into kinetic energy of the moving stream, and finally into heat. But so long as this process is not carried to its final conclusion, so long as the water is still above sea-level, its energy of position or of motion is available to us for utilization in water-wheels or turbines, or any other suitable device. And of course the best conditions for tapping this source of power are presented in waterfalls.

Now the location of a waterfall is a matter lying outside of our control; nature has not consulted our convenience in the selection of sites for these things. But why should we remain dependent upon nature? Why not make a waterfall where we want it? Remember nature's arrangement: a lower reservoir, the sea; the sun's rays lifting the water from the surface of this sheet, the wind carrying it to a suitable condensing ground; the river and waterfall, setting free for utilization the energy pent up in the waters previously elevated.

There is no feature in this arrangement which we cannot, if we chose, imitate. We can build reservoirs; it should be possible in some way to utilize the sun's rays to vaporize water, and, if desired, to work a pump with the steam so generated, so as to raise other portions of water to a higher level. It may be

urged: why not utilize the sun's rays directly for power purposes? There is an obvious objection. The sun shines but a fraction of each day, the stream of energy which it sends to us is intermittent and variable. So it would seem that the most rational procedure would be to store energy by day, and draw, as occasion requires, from our store. And it appears that water reservoirs are about the cheapest form of energy store available for the purpose. A most interesting account of a project of this character, in part realized, it appears, at the present day, has been given by R. A. Fessenden before the British Association, and is reproduced in our SUPPLEMENT of this week.

Fessenden proposes to install jointly a plant for utilizing the sun's radiation, and for exploiting wind-power, each feeding the same water reservoir. The general arrangement is shown in ideal representation in the accompanying illustration. In the actual installation, the detail features of which are not disclosed,* an existing mine shaft has been utilized. At night the radiation plant would necessarily be at rest, but on the other hand the wind is usually higher than during the day. There is thus a tendency for conditions to even themselves out, and the working of the joint plant would approach uniformity. Fessenden's paper represents a most interesting step in a direction for which there seems to be promise of important ultimate developments, and should be read by every one interested in the major events in the progress of arts and science.

Women and Scientific Research

In a recent paper published in Science by Professor Cattell, under the title "Statistical Study of American Men of Science," reference is made to the fact that women are contributing but a very small share to productive scientific work. In 1910 only eighteen women are found among the first thousand scientific persons. The author says, in part: "There are now nearly as many women as men who receive a college degree; they have on the average more leisure; there are four times as many women as men engaged in teaching. There does not appear to be any social prejudice against women engaging in scientific work, and it is difficult to avoid the conclusion that there is an innate sexual disqualification. . . . But it is possible that the lack of encouragement and sympathy is greater than appears on the surface, and that in the future women may be able to do their share for the advancement of science."

Not unnaturally this passage has brought out some discussion of the point raised. Two letters appear in the correspondence column of Science over the signatures of ladies, who rise in protest and in defense of their sex. They urge that the general conditions of education and of college administration are such as to place unnatural obstacles in the path of women bent upon scientific attainment.

One correspondent complains that the whole spirit of a girl's education, from childhood up, lays far too much stress upon attention to her apparel and adornment, that the boy is free from such trammels and has correspondingly more leisure to give thought to things of greater worth. A boy is taken by his elders to visit various places of practical interest, thus preparing his mind for the solid duties and life work of the man. No one thinks it necessary to pay the same service to girls. Yet, the writer claims, the practical instinct is innate in girls as in boys. "It was a little girl who once asked: Why do the cars lean in when they go around a curve?"

It must be admitted that there is justification for these statements. Men do like to see women tastefully attired. The bluestocking has never been very popular. But one cannot quite shake off the feeling that the fault, if fault there be, does not rest entirely with the male sex. If women are in this matter the victims of circumstances, one rather suspects that most of them are willing enough victims.

And, perhaps, this spirit of willingness, rather than the force of circumstances, is one of the true causes why women do not figure as prominently among scientists as men. One might ask the question whether it is desirable that they should. There are some walks in life, some missions, which are eminently woman's sphere. The pursuit of scientific research is perhaps not one of these. This, however, does seem probable, that the present proportion of eighteen in one thousand does not represent a fair condition, whatever may be the causes of the disparity.

More convincing, perhaps, than the first plea, is the second complaint made: women, it is claimed, are hardly considered seriously as candidates for major positions at universities. And it is the holders of such positions who are contributing the main share to the advancement of science.

* It is not stated whether this plant comprises a "solar radiation plant" or is merely wind-driven.

Sea Water a Liquid Food

It has hitherto been supposed that marine animals derive their food from each others' bodies and, in the last analysis, from plants, says Prometheus. A few years ago, however, Puettner discovered that the sea contains dissolved food materials, upon which some marine animals, notably sponges, appear to live exclusively. A given volume of sea water contains in dissolved condition 24,000 times more carbon than it contains in the form of organisms. Puettner proved that one species of sponge, if it were compelled to exist upon ready formed food, could obtain in one hour only 1/2300 of the quantity of carbon which it consumes in that time; and in order to obtain even this small quantity, it would have to fish over twenty times the volume of sea water which would suffice to supply it with all the carbon it requires in the form of dissolved complex carbon compounds. Very interesting in this connection is the observed fact that comparatively small quantities of ready formed food are found in the digestive cavities of the lower marine animals. Hence sea water is, for a great many invertebrate animals, a nutrient fluid from which they absorb food, as the cells of animal tissues absorb food from the bodily fluids, animal parasites from the media in which they live, and all plants from their environment. The sea is an inexhaustible reservoir of food.

The Speaking Clock

There is nothing outwardly remarkable, according to Das Echo, in the appearance of the ingeniously constructed timepiece known as the "time-stating clock." But every quarter of an hour an agreeable voice issues from it, announcing the correct time, as, twelve o'clock, twelve fifteen, twelve thirty, etc.

The works of the clock actuate a stout belt, which runs over a roll connected with a sounding box.

Upon this belt, or rather film, the hours, which have been recorded by a phonograph, are impressed by galvanization on a copper plate.

The mechanism which moves the hands is connected with the speaking device, and this with a funnel which reenforces the sound and projects it outward through a finely grated opening attached to the narrow side of the clock.

At night a touch on a lever reduces the clock to silence. But if one wakes and wishes to know the hour without striking a light, an easily found button is pressed and the clock immediately states the time.

The speech film is practically indestructible and occupies very little space since, because of its elasticity, it may be wound upon a very small roller.

Electricity

Telephone Train Dispatching.—The Pennsylvania Railroad has installed a complete telephone train-dispatching system at its terminal in Philadelphia, which is said to be the first of its kind in a terminal station.

An Electrical Week at Turin.—The International Electrotechnical Commission is to meet at Turin, Italy, during the week beginning September 11th, 1911. At the same time there is to be at Turin an International Exhibition of Industry and Labor. Recently it has been planned to have as well an International Electrical Congress of the Applications of Electricity. This proposed meeting is being organized by a committee appointed by the Associazione Elettrotecnica Italiana.

A Simple Current Test.—A letter published in a recent number of Power suggests a simple method of determining whether the current in a lamp socket is alternating or direct. On holding one pole of a permanent magnet against one side of the globe of a lighted lamp, it is found that if a direct current is flowing through the filament, the latter will be either attracted toward or deflected from the magnet, while if alternating current flows through the lamp, the filament will vibrate, due to the alternation.

Chicago Automatic Telephone Service.—The installation of automatic telephone service in Chicago is progressing satisfactorily. Four exchanges are being built in the business section, and four others in outlying districts. The central exchanges are to have a capacity of 34,500 lines to start with, but the capacity will eventually be doubled. The system when completed will have a capacity of a million lines. The Illinois Tunnel Company has already 37,000 contracts for its new system. It expects to start service before the first of April with 20,000 telephones.

The Chicago Electrical Show.—The annual show of the Electrical Trades in Chicago opened on January 7th in the Coliseum. It is one of the most successful exhibitions of its kind, there being about a hundred exhibitors. The annex of the building is taken up almost entirely by the United States government, in which all electrical apparatus pertaining to various departments, is on exhibition. One of the most interesting of these is the representation of the electrical equipment of a battleship. The navy has recently decided upon the use of electricity for cooking purposes aboard warships, and this is illustrated in the government display. The main hall of the Coliseum is beautifully illuminated, the roof being draped to give the appearance of a huge tent with a rectangular opening in the center, through which the blue sky and fleecy clouds may be seen. This effect is produced by means of indirect lighting. The booths are in the form of pergolas, covered with vines.

Cell Sensitive to Light.—A unique electrolytic cell which is sensitive to light was recently described by M. H. Pelabon before the French Academy of Science. The negative electrode of this cell is pure antimony, and the positive electrode an alloy of antimony and selenium. The solution in which the electrodes are immersed consists of trichloride of antimony and hydrochloric acid. If this cell is kept under uniform conditions of temperature and in perfect darkness, its voltage remains constant. However, should the positive electrode be illuminated, the voltage would rise at once nearly fifty per cent. But the cell would not maintain this voltage, even though the light were kept steadily shining on the electrode, but would gradually diminish, until, after a period of about 20 minutes, it would reach its initial voltage. Thereafter, should the light be cut off, the voltage would drop at once about fifty per cent below the initial voltage, and then would rise slowly to the normal voltage.

Engineering

Hudson Siphon 1130 Feet Deep.—For several years boring operations have been carried on in the search for solid rock below the Hudson River, through which to carry the siphon leading to the Catskill aqueduct on each side of that river. Solid rock has now been found at a depth of 1,130 feet.

The Latest British Dreadnought.—The four new dreadnoughts to be built this year for the British navy will be 555 feet long, and of 24,000 tons displacement. They will mount 10 13½-inch guns, all in turrets on the center line, and 16 4-inch guns for torpedo defense. The speed will be 21 knots on an 8-hour trial.

A Fire College.—The establishment in New York of a fire college, the first of its kind in the world, brings to mind the fact that this city was the first to organize trained volunteer companies and the first fire department equipped with a paid force. To the original work done by this institution is to be credited most of the modern fire-fighting and life-saving devices.

Fuel Oil on Railroads.—That the advantages of fuel oil in place of coal in the operation of railroad trains are coming into increasing recognition, is shown by the growing consumption on those railroads that are advantageously placed for the purchase of oil. The consumption on the railroads of the United States in 1909 amounted to 19,939,394 barrels, an increase of 18 per cent over the previous year.

Travel of Shots Under Water.—A naval board is carrying on experiments to determine the course taken by a projectile after it strikes the water, with a view to determining what damage a shot may do to the submerged portion of a vessel after it has passed below the surface. The flight of the projectile is being determined by placing a series of fish nets below the water, and noting the course by the perforations.

Parlor Cars at Panama.—The institution on the first of this year of a parlor car service on the Panama Railroad is suggestive of the interest which is being taken in the construction of the great canal. There will be an observation platform, capable of seating twenty people, on each end of the car. If, as expected, the car proves to be profitable, all passenger trains will be equipped with one of this type.

The Loftiest Railway.—The highest railway in the world, according to "Peru To-day" is to be found on the Morococha branch of the Central Railway of Peru. The summit of this line, which is broad gage, is exactly 15,365 feet above sea level. To reach this point from the sea, the line passes through 57 tunnels, over a dozen important bridges and through 13 switchbacks. Although the grades are heavy, no rack propulsion is utilized.

Protection Against Submarines.—The French are experimenting with a new device for protecting warships against submarines when the former are stationary. It consists of groups of cylinders, about two inches in diameter, filled with high explosives and moored around the battleship, the cylinders being so connected with each other that when a submarine comes in contact with one or more of them, it is entangled by the entire group, whose simultaneous detonation wrecks the submarine.

Coal Dust Explosion Experiments.—Experiments already carried out by the Mining Association of Great Britain to determine the phenomena of coal dust explosions have shown that, under favorable conditions, such explosions can be made to occur. When a jet of dust was ignited in an artificial gallery, a large cloud of dust was ejected, and a flame shot out of the mouth of the gallery, spreading through the dust to a distance of 180 feet. The report of the explosion was audible for a distance of seven miles.

Legal Notices

Classified Advertisements

Advertising in this column is 75 cents a line. No less than four nor more than 12 lines accepted. Count seven words to the line. All orders must be accompanied by a remittance. Further information sent on request.

READ THIS COLUMN CAREFULLY.—You will find inquiries for certain classes of articles numbered in consecutive order. If you manufacture these goods write us at once and we will send you the name and address of the party desiring the information. There is no charge for this service. **In every case it is necessary to give the number of the inquiry.** Where manufacturers do not respond promptly the inquiry may be repeated.

MUNN & CO., Inc.

BUSINESS OPPORTUNITIES.

Inquiry No. 9173.—Wanted, manufacturers of machinery for removing fibre (coir) from cocoanut husks.

WE WANT and will finance the manufacture and sale of a patented general utility article having special features of popularity, suitable mail order, export, drug, stationery, hardware, department store trade. Only written propositions considered. Dan Danehy & Co., 25 Broad Street, New York.

Inquiry No. 9175.—Wanted, manufacturers of a machine called Beiasco or Blasco, used in the manufacture of ostrich feathers.

WANTED.

WANTED.—Young man (Christian) night student in chemistry, desires a position in a chemical laboratory; an analytical laboratory is preferred. F. L., Box 773, N.Y.

Inquiry No. 9188.—Wanted, manufacturers of rubber block tires for one ton trucks.

LOCAL REPRESENTATIVE WANTED.—Splendid income assured right man to act as our representative after learning our business thoroughly by mail. Former experience unnecessary. All we require is honesty, ability, ambition and willingness to learn a lucrative business. No soliciting or traveling. This is an exceptional opportunity for a man in your section to get into a big-paying business without capital and become independent for life. Write at once for full particulars. Address E. R. Marden, Pres., The National Co-Operative Real Estate Company, 378a Marden Building, Washington, D. C.

Inquiry No. 9190.—Wanted, name and address of parties who make for sale pattern letter moulding machines and matrix.

WANTED to manufacture small specialties or electrical house goods specialties. Unlimited capital, large plant. A. E. Farrenkopf, 534 Bleeker St., Brooklyn, N.Y.

Inquiry No. 9202.—Wanted to buy the Rose fountain pen.

WANTED to purchase patent rights on good advertising specialty that can be manufactured in large quantities at small cost. Must be something new and catchy. Write Augustine Printing Co., Grand Island, Neb.

Inquiry No. 9207.—Wanted, names and addresses of firms making star section iron and steel suitable for lightning rods.

MISCELLANEOUS.

Inquiry No. 9210.—Wanted, names of owners of deposits of pumice or volcanic ash.

Translations from French, German, Italian. Specialty Patents, Technical and Scientific Articles. Absolute Accuracy, Fluent English and Correct Technical Terms. Translations, Box 773, N.Y.

Inquiry No. 9208.—Wanted, the address of the manufacturer of the "Little Giant" Pump.

AUTOMOBILISTS ATTENTION.—Fur-lined coat, never worn, lined throughout with the best Australian mink, elegant Persian lamb collar, cost $175, will sell for $85; also pair of cinnamon bear robes, $30, cost $120. W. Scott, 121 East 27th St., New York.

Inquiry No. 9209.—Wanted, names of owners of gold placer properties.

LISTS OF MANUFACTURERS.

Inquiry No. 9211.—Wanted, addresses of parties who can ship ore containing vanadium, molybdenum, or bismuth.

COMPLETE LISTS of manufacturers in all lines supplied at short notice at moderate rates. Small and special lists compiled to order at various prices. Estimates should be obtained in advance. Address Munn & Co., Inc., List Department, Box 773, New York.

Inquiry No. 9212.—Wanted, names and addresses of owners of fluor spar properties.

SALE AND EXCHANGE.

Inquiry No. 9213.—Wanted, addresses of parties making Viscol compound for shoes or shoes made from leather treated therewith.

A LIST OF 1,500 mining and consulting engineers on cards. A very valuable list for circularizing, etc. Price $15.00. Address Munn & Co., Inc., List Department, Box 773, New York.

Inquiry No. 9214.—Wanted, address of maker of "Piako," a fastening for ladies' dresses.

Inquiry No. 9215.—Wanted, machine for producing a good finish on hammer and other handles.

Inquiry No. 9216.—Wanted, to buy a sewing machine having a very long arm for special work.

Inquiry No. 9217.—Wanted, the names and addresses of manufacturers of machinery for shelling almonds and peanuts.

Inquiry No. 9218.—Wanted, the names and addresses of manufacturers of outfits for salting almonds and peanuts.

Aeronautics

First Aviation Victim of the New Year.—While making an exhibition flight at Belgrade, the capital of Servia, a Crotian aviator named Roussijan is reported to have fallen to his death on January 9th. His machine became uncontrollable while in flight. He attempted to alight in a river, but instead collided with a building. The death of a lad named Archer, who was reported to have been killed at Salida, Col., recently in a machine propelled by an electric motor, has been found to be a canard. Thus the year 1910 has one less aviation victim to account for.

Protective Legislation for Aviators.—The interest in aviation aroused by the recent meets at Los Angeles and San Francisco has resulted in the framing of bills to license aeroplanes and protect their pilots by the California Aero Clubs. These bills will be submitted to the Legislature of that State in the near future. Among other things, they provide that an aeroplanist who is obliged to descend upon private property shall not be liable except for the actual damage he causes, and an amendment to the penal code is asked for, making it a felony to shoot at an aeroplane in flight.

The Bennett Cup Race for 1911.—The rules for the international aeroplane cup race for the Bennett trophy for the present year were promulgated at the meeting of the International Aeronautic Federation on January 10th. They provide for a 150-kilometer (93.15-mile) race above a suitable aerodrome. The race will be held in England owing to Grahame-White's victory for that country at Belmont Park last November. Officers of the Aero Club of America attempted to have the rules changed so that only machines built in the countries which they represent could be used in the race, but in this they were unsuccessful.

Delivering Newspapers by Aeroplane.—The first attempt on record at delivering newspapers by aeroplane was made by D. Masson on January 7th during the Los Angeles meet. Masson left Los Angeles in the forenoon with several bundles of newspapers to be delivered at Pomona and San Bernardino. He missed the former place and became lost among the hills to the north of it. Finally his fuel gave out and he descended rather heavily, 12 miles west of San Bernardino. Despite the breaking of an oil tube, he finally reached this place, 5 hours and 40 minutes after leaving Los Angeles. While giving an exhibition in the park there during the afternoon, his Curtiss-type biplane again landed heavily and was badly damaged.

Winner of the Statue of Liberty Prize Still Undetermined.—The International Aeronautic Federation, at its special meeting on January 11th in Paris, did not give a decision upon the winning of the Ryan $10,000 prize by Moisant and Grahame-White's protest against same. The whole matter was referred back to the Aero Club of America for a new classification and new results. While White was the only competitor who had complied with the original requirement of a flight of an hour at the Belmont Park meet before attempting the prize flight, it was shown that he had fouled the fifth pylon in starting, which should have caused his disqualification. According to Rule 29 of the Federation, the rules of aeronautic meets cannot be changed after publication, except with the consent of the contest committee of the governing club. As it was not shown that the abolishing of the hour-flight requirement was done with the consent of the contest committee of the Aero Club of America, a majority of the delegates present passed a resolution declaring that the change in the rules did not conform with the rules of the International Aeronautic Federation, and that, therefore, the matter was referred back to the Aero Club of America for straightening out.

Science

A New Rain Gage.—A new form of rain-gage, introduced by Messrs. Casella & Co., of London, is insulated from the effects of temperature in either evaporating or freezing the collected rain-water. The method of insulation is extremely simple, consisting of an air-space between the inner and outer walls of the receiving-vessel.

Atmospheric Exploration in Uruguay.—It is understood that aerological observations (*i. e.*, soundings of the upper air) will soon be undertaken at the National Physico-Climatological Institute of Montevideo. A letter from the newly appointed director of the Chilean meteorological service, Dr. Knoche, states that similar investigations are contemplated at Santiago.

International Magnetic Study.—The work of the organization heretofore known as the "International Commission on Terestrial Magnetism and Atmospheric Electricity" will henceforth be limited to the former of these two subjects, and its title has accordingly been changed to "International Commission on Terrestrial Magnetism." A separate commission on atmospheric electricity will be apointed by the International Meteorological Committee.

Meteorological Units.—Reforms in the existing units used in meteorology have been repeatedly urged in recent years; especially the adoption of the absolute temperature scale and the substitution of C.G.S. units of force for the height of the mercurial column in the measurement of barometric pressure. However, the International Meteorological Committee, at its recent meeting in Berlin, decided that it could not yet give its approval to any of these suggestions.

Shaw's Lectures on Meteorology.—Lectures on "Modern Meteorology, Dynamical and Statistical," to which admission was free to the public, were given by Dr. W. N. Shaw, F.R.S., at the new quarters of the Meteorological Office, in Exhibition Road, London, on November 21st and 28th. Two collections of lectures by Dr. Shaw are to be published shortly under the titles "Forecasts of Weather" and "Climates of the British Possessions," the latter being really a work on general climatology, with illustrations drawn from the British possessions.

What Snowstorms Cost.—The cost of snowstorms to a large town is illustrated by the accounts of the Corporation of Manchester (England), where it is stated that to clear away falls aggregating 15 inches in depth during the winter of 1909-10 entailed an expense of $29,705 and gave employment to no fewer than 15,640 men. To give an idea of the probably much greater expense of such work in our large American cities it may be stated that the average annual snowfall of New York is 37 inches, Boston 45 inches and Philadelphia 22 inches; that these cities cover a much larger area than Manchester, and that wages are higher here than in England.

Meteorology in Argentina.—From a recently published description of the Argentina meteorological service, by R. C. Mossman, we learn that this service now possesses 32 first-class stations, equipped with automatically registering instruments; 148 second-class stations, where observations are made at 8 A. M., 2 P. M., and 8 P. M.; 10 third-class stations, and 862 fourth-class stations. The daily weather map includes, also, reports from several stations in Brazil, Chile and Uruguay, and thus shows the meteorological conditions reigning from Para (Brazil), situated on the equator, to the southernmost limits of Argentina, extending over a region of 55 deg. latitude, reports being received by wireless telegraphy from New Year's Island and Ushuaia. The service also maintains 111 river-gages, and issues flood-warnings, besides carrying on extensive observations in terrestrial magnetism and seismology.